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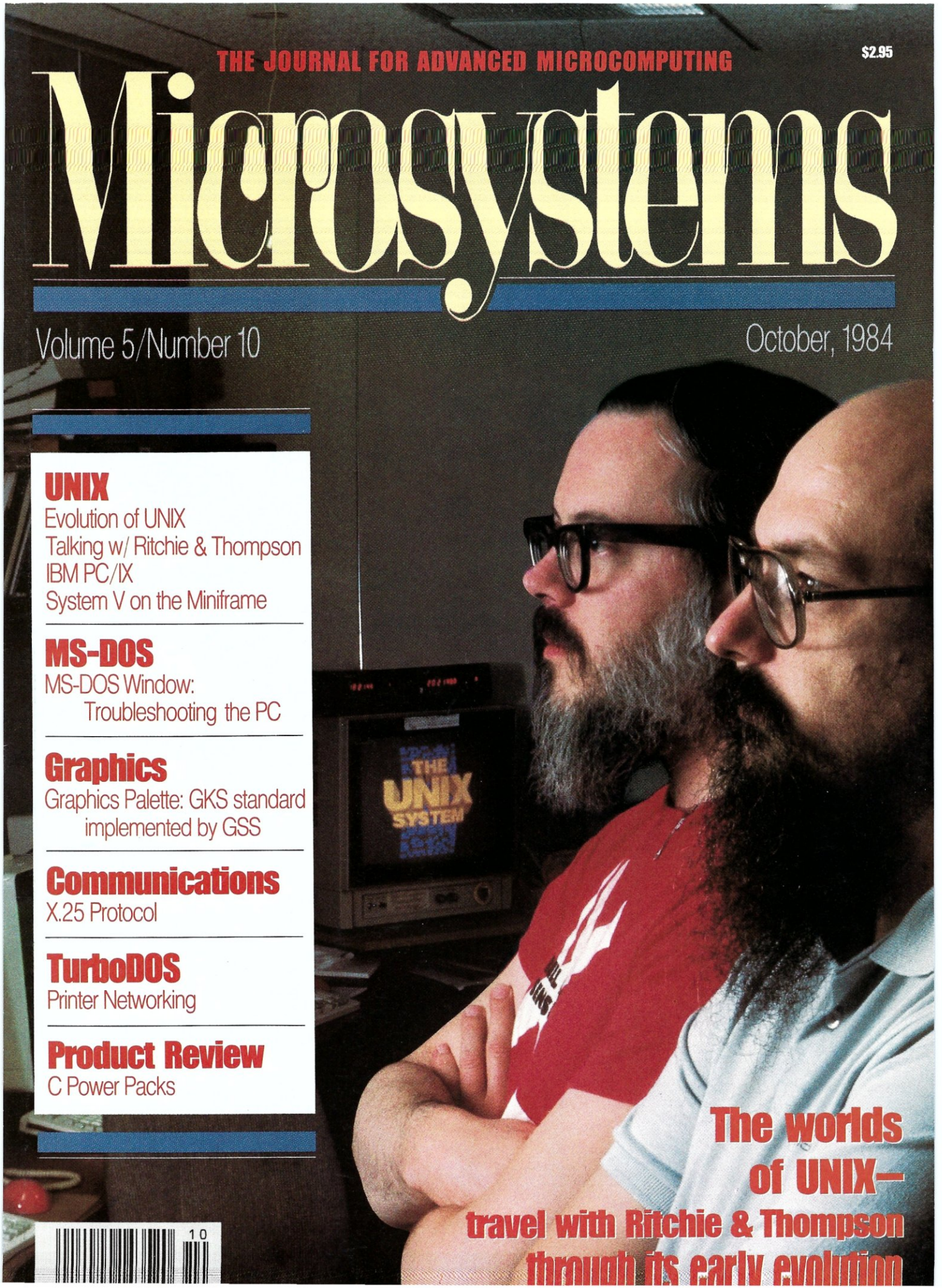
Microsystems

Volume 5/Number 10

October, 1984



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Communications
X.25 Protocol

TurboDOS
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Product Review
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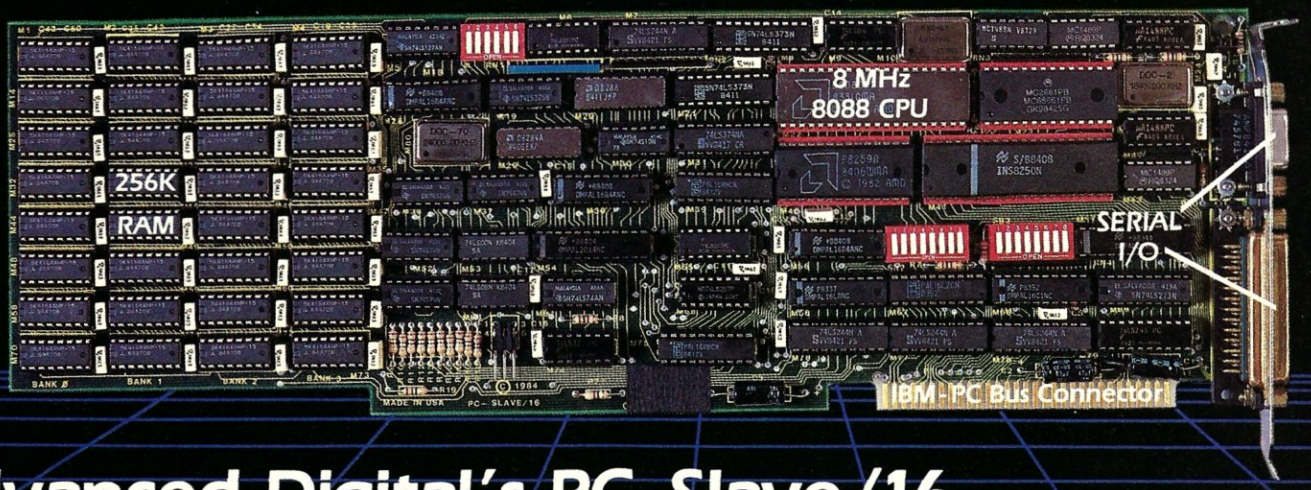

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Systemaster II. Responding to market demand for speed and increased versatility, Teletek is proud to announce the availability of the next generation in 8-bit technology — the new Systemaster II! The Systemaster II will offer two CPU options, either a Z80B running at 6 MHz or a Z80H running at 8 MHz, 128K of parity checked RAM, two RS232 serial ports with on-board drivers (no paddle boards required), two parallel ports, or optional SCSI or IEEE-488 port. The WD floppy disk controller will *simultaneously* handle 8" and 5¼" drives. A Zilog Z-80 DMA controller will provide instant communications over the bus between master and slave. Add to the DMA capability a true dedicated interrupt controller for both on-board and bus functions, and the result is unprecedented performance. Systemaster II will run under CP/M 3.0 or TurboDOS 1.3, and fully utilize the bank switching features of these operating systems.

SBC 86/87. As the name indicates, Teletek's new 16-bit slave board has an Intel 8086 CPU with an 8087 math co-processor option. This new board will provide either 128K or 512K of parity checked RAM. Two serial ports are provided with individually programmable baud rates. One Centronics-compatible parallel port is provided. When teamed up with Systemaster II under TurboDOS 1.3, this 5MHz or 8MHz multi-user, multi-processing, combination cannot be beat in speed or feature flexibility!

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The worlds of UNIX

—travel with Ritchie and Thompson through its evolution

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MICROSYSTEMS (ISSN #0199-7955) is published monthly by Ziff-Davis Publishing Company, One Park Avenue, New York, N.Y. 10016.

Second Class postage paid at New York, N.Y. 10016 and at additional mailing offices. POSTMASTER: Send address changes to MICROSYSTEMS, PO Box 2937, Boulder, CO 80322. Subscriptions are $26.97 for 12 issues. Canadian prices are $5.00 per year additional; other foreign $8.00 per year additional (U.S. currency only). For information or questions about subscriptions phone: (800) 631-8112.

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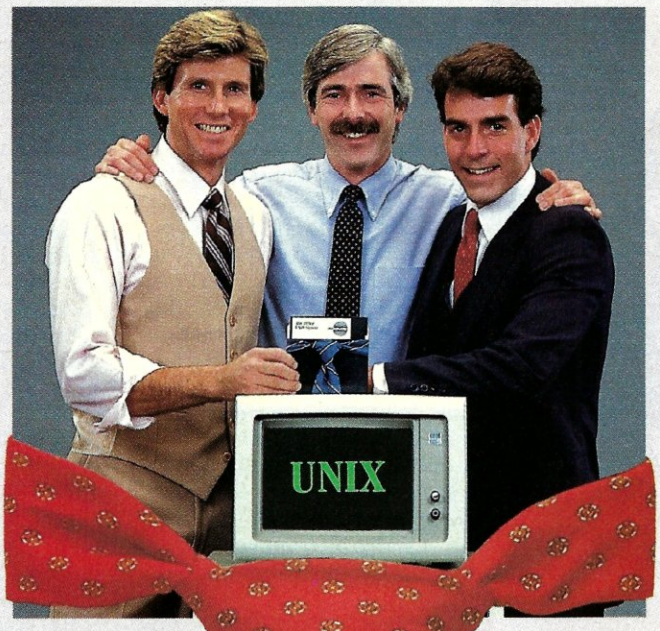

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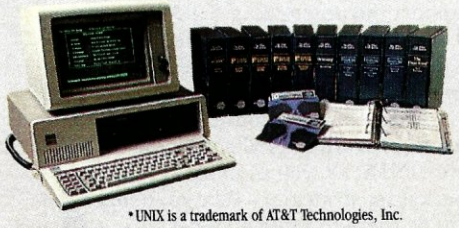

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Getting UNIX Software Down to Business

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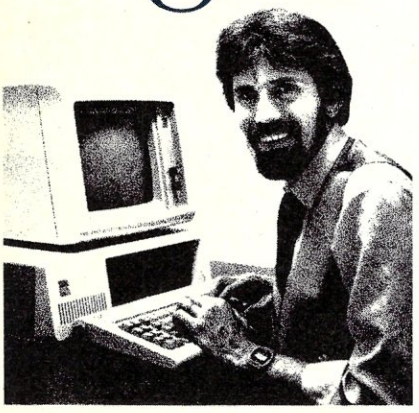
Editor's Page



Conditions for portability... the S-100 bus— a response to a reader

by Mark Rollins

Consider the following situation: You are the author of a new word processor called FWP (Fancy Word Processor). You are excited by the prospects for your new product, and everyone you've given it to so far loves it—they all think it's a winner. Now, clearly, once the product is developed, you have one primary goal: to maximize the sales, while minimizing the hassles to market and distribute it.

Wouldn't it be nice if, when customers ordered it, you could simply ask what machine it was targeted to run on, and then provide the diskette (or other distribution media) format for that machine? And I do mean for *any* machine.

Obviously, that is not reality, at least at this point. It assumes a single executable module, which means machine code for one specific CPU. But you've been clever: you anticipated that, and wrote the program in a high-level language. So, a viable alternative is to recompile it for the customer's machine.

The problem is that you have only been afforded *some* level of portability. There is no language that is standard across all compilers from every vendor, even on a given machine.

To get a perspective on the problem, let's look at the elements that go into writing a single program that (a) performs I/O to physical devices, and (b) needs to be universally portable. They are: (1) the program, (2) a compiler, (3) an operating system, and (4) the physical hardware.

The compiler takes the program source and generates executable code for a specific CPU. For portability, none of that code can perform actual I/O; instead, it makes I/O requests to an operating system, which channels them to the specific hardware. If that chain is modular and standard, then portability is achieved by simply writing the OS device drivers for any specific machine.

Thus, the ideal environment for universal portability is an operating system that runs on all machines and a compiler that talks to devices through the operating system, rather than directly. Every single component short of that decreases the portability and increases the complexity of the environment—and therefore the amount of work necessary on somebody's part. This is an issue of extreme importance to the industry that we will continue to cover in these pages.

Response to S-100 letter

We have received a letter that complains about our continuing editorial trend to move away from support of S-100 systems ("Letters to the Editor," this issue). We have a charter at *Microsystems* to keep our readership informed of state-of-the-art issues in the world of microcomputers. It is a readership identified as the system and software development community; and the industry is so fast-paced that developers must not only remain current, but must anticipate new trends, in order to survive.

We are therefore fortunate that our charter not only enables, but compels us to cover the eclectic, even esoteric, interests and needs of this community—which is becoming more and more professional—in order to help them get their jobs done. On the other hand, because that charter also compels us to remain leading edge, it does not force us to be bound to the majority.

The New York Times (Tues., Aug. 14, 1984) published a breakdown of the sales of computer systems for June, 1984: IBM PC and XT—39%; Compaq (PC compatible)—10%; Apple Macintosh, C, and E—28%; all others (including all other PC compatibles, Commodore 64s, Atari's, all 68000s, all S-100 systems, and all other 8-bits)—23%. That breakdown, of course, does not identify the relationship between current sales and the existing installed base of microcomputers. However, if the majority of the development community is not already 16-bit IBM compatible, it is moving there fast.

Now, we *do* feel the installed base of S-100 systems is valuable, and that the capabilities of S-100 systems provide for the expansion of those systems into state-of-the-art processing. Nevertheless, for whatever reasons, the S-100 community just is not moving aggressively in the current direction of 16-bit MS-DOS and UNIX.

There are S-100 systems, like the CompuPro 8/16, that are selling well—within their spheres. But they aren't getting serious penetration. We feel this is partially because they still function as 8-bit systems, with some 16-bit capabilities. There is a crying need to upgrade these systems to full 16-bit processing capabilities, as Dual Systems has done with its S-100 68000 UNIX system.

The point is, we still *very strongly* support the potential of S-100 systems. If the vendors for those systems make a state-of-the-art, 16-bit processing environment available to the development and end-user communities—and that means providing CPU cards, MS-DOS, and UNIX, as well as more aggressive marketing strategies—*Microsystems* will be there to write about it.

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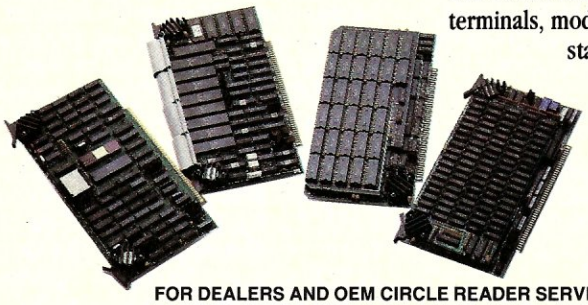

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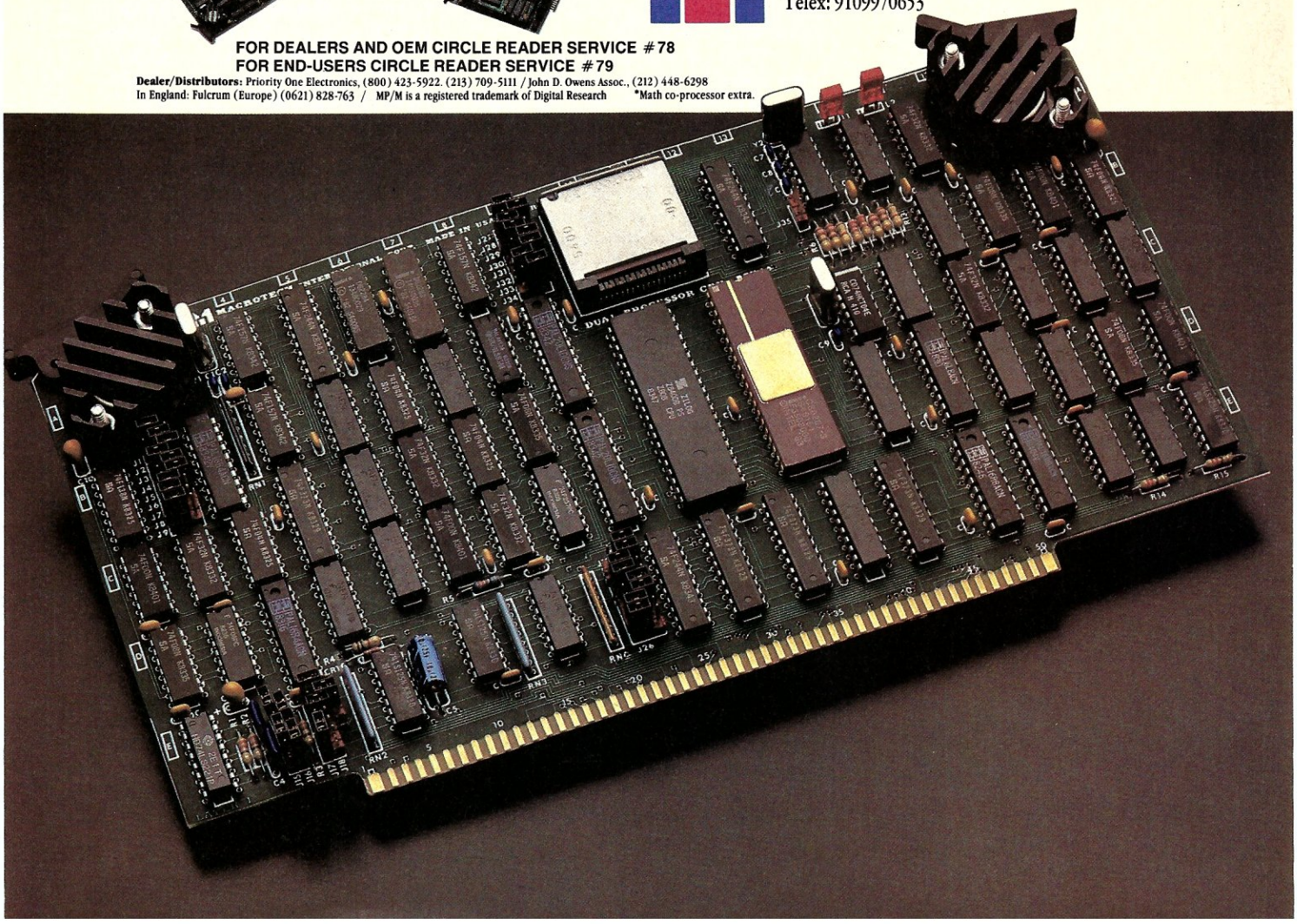

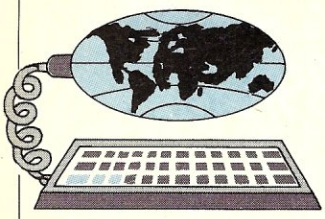

News & Views

Random rumors and gossip, plus a view of the industry's latest trends

by Sol Libes

IBM is rumored to be readying a turbo version of the PC/XT system that will have a much higher clock speed. Several PC-compatible vendors have already introduced such products. Running at a higher speed significantly improves of windowing and integrated database/spreadsheet programs. . . . IBM is also expected this month to finally announce its multiuser version of the PC, which uses the Intel 80286 microprocessor. Speculation is that IBM will use a UNIX operating system (possibly XENIX) with windows and MS-DOS emulation features. . . . Future Computing, a respected market research organization, estimates that this year IBM will ship 1.2 million PCs, while Apple will ship 900,000 systems; last year, the figures were 450,000 PCs and 637,000 Apples shipped. Thus they expect '84 to be the first year that IBM overtakes Apple.

UNIX news

Mark Ursino, operating systems product manager for Microsoft, gave very interesting talk at the Comdex show in May. Here are some quotes from his talk on UNIX.

"UNIX, if you add up all 50 flavors, does dominate the market for multiuser general-purpose micro-based business computers . . . and that market is only about 10% of the general-purpose microcomputer industry . . . the multiuser market does not have the critical mass to garner general industry support in terms of value-added products. . . . this market is being treated as a poor step-child by the industry in general because there is no true dominant standard . . . there is no true UNIX standard in the sense that there are CP/M and MS-DOS standards."

"Recently I read an article where an AT&T spokesperson was boasting that there were in excess of 70,000 computers of 75 types running UNIX. That boast is very revealing when you put it in perspective. 70,000 computers of 75 types makes for an average of only 933 computers of any given type. Not a big market to sell into! But consider this: of these 70,000 plus computers, at least 25,000 are Tandy model 16s running XENIX. 15,000 of them are Fortunes, running ForPro, which is a derivation of XENIX, which is derivation of UNIX. 20,000 are Altos systems also running XENIX, and at least 5,000 or more are PDP-lls or VAXs. So that leaves about 10,000 machines averaged over 68 types, or about 147 per type. . . . the best that can be said for UNIX, then, is that UNIX is a standard technology upon which a dozen or so commercial products are based."

"To put AT&T's 70,000-system boast in yet another perspective, AT&T has licensed 70,000 commercial systems in four years of commercial licensing. Apple distributed 70,000 Macintoshes in four months. Consequently, although UNIX is a real commercial force, it does enjoy some unearned perceptual advantages. Because 50 flavors get wrongly treated as one commercial product, the small number of systems in use cuts AT&T's boast to size."

From Mark's comments it is apparent that of the 70,000 licensed commercial installations of UNIX, more than 60,000 are running XENIX. Still, XENIX contributed only 3% of Microsoft's $75 million in 1983 revenues, according to chairman and founder William Gates. It is likely that Microsoft, considering development, support and promotion expenses as well as AT&T royalties, has yet to show a profit with XENIX. If that is the case, one wonders about the future of UNIX.

Electronics Business magazine predicts that "a shake-out is on the way. And every UNIX system supplier outside of the Big Three—AT&T; the University of California at Berkeley (with its BSD 4.2); and Interactive Systems Corp. (Santa Monica, CA; supplier of the PC/IX UNIX system for IBM's PC)—stands a chance of getting burned."

Running MS-DOS under UNIX

Several suppliers of UNIX operating systems are promising that MS-DOS programs will be able to run with their operating systems. The Mark Williams Co., suppliers of Coherent, a UNIX implementation for the PC, are promising that their system will be able to run MS-DOS software by year-end via an MS-DOS emulator mode. And Lantech Systems has announced that their uNETix operating system will also shortly have MS-DOS capability. Lantech also claims to have also added a BASIC compiler to uNETix that is compatible with Microsoft BASIC.

Digital Research (CP/M) and Softech Microsystems (p-System) have already added limited MS-DOS capability to their operating systems.

IBM and UNIX

IBM has now at least five different versions of UNIX that it either offers or is evaluating; the latest is from National Semiconductor Corp. IBM's Information Systems Business unit is now supplying a version of NS's Genix32 operating system to several universities that

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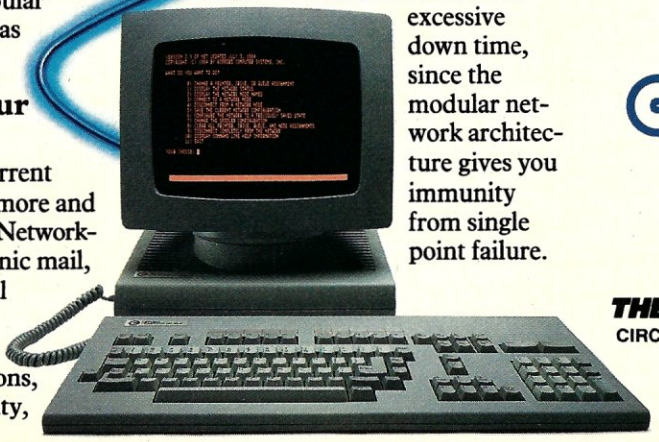

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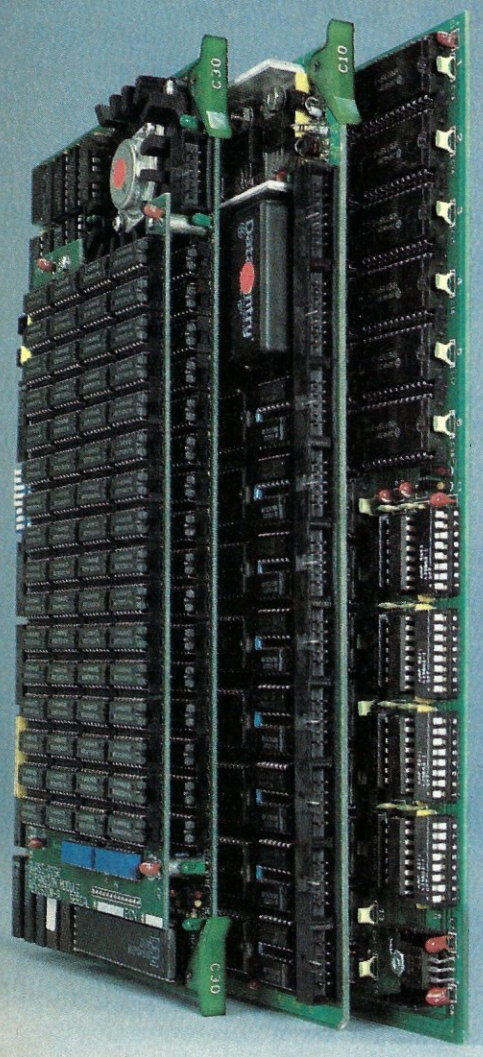

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News & Views

Continued from page 8

are developing local area networking systems with PC workstations containing 16032 coprocessor cards. Genix32 is based on the University of California at Berkeley's 4.2 BSD version of UNIX.

IBM currently offers CPIX for the Serial/1 (an implementation of UNIX Version 7), PC/IX for the PC/XT (an implementation of UNIX System III), and a UNIX implementation which runs on large mainframes under its TSS system. IBM is also rumored evaluating Microsoft's XENIX for its forthcoming 80286-based multiuser system.

Morrow multiuser system

George Morrow, outspoken chairman of Morrow Inc., a leading S-100 vendor, said not too long ago that "We'll ship 68000s over my dead body." Well, Morrow has announced a 68000 S-100 system, and I am pleased to tell you that George is still as alive and outspoken as ever.

The system, called "Tricep," uses a standard Morrow 14-slot S-100 mainframe with six boards: a 68000 CPU card that also contains a Motorola 68451 memory management unit, 512K of RAM on two boards, hard disk and floppy disk controller cards, and an I/O board with four serial channels. Also in the box is a choice of a 16- or 32-MB 5.25" Winchester and a 400K floppy disk drive. The UNIX operating system is a System V implementation with enhancements done by Unisoft Systems of Berkeley. This entry-level system, which supports up to four users, is $5500 in OEM quanties of 10-30.

By the time you read this, SIG/M (Special Interest Group for Microcomputers, Amateur Computer Group of New Jersey, Inc.) is expected to have released version 3 of ZCPR, written by Rich Conn. The new version will probably occupy 15 to 20 8" single-sided disks. People who would like to get a copy quickly should buy it from *Echelon Inc., 101 First St., Suite 427, Los Altos CA 94022; (415) 948-5321.* The ZCPR3 core is $39 with sample documentation. A set of 12 utility disks are $89, the printed manual is $24, and Syslib3 is $16. Ordering the disks from SIG/M will save only a small amount of money and will take a much longer time to get. Also, SIG/M does not plan to print the documentation.

For complete SIG/M software information, send $2.50 ($4 foreign) for printed catalog to *SIG/M, Box 97, Iselin NJ 08830.*

The PC-BLUE user group has not issued any new software. Currently 60 volumes are available from the group. A copy of the printed PC/BLUE software catalog can be obtained from *Sol Libes, Box 1192, Box 106 Church Street Station, NY NY 10008;* or call *(212) 864-4595.* Many of the clubs and individuals who distribute the SIG/M software now also distribute the PC/Blue software. It is therefore recommended that they be contacted first to obtain copies of the volumes.

The top 10 hardware

Future Computing, after surveying close to 400 computer stores last March, reported the following top 10 system sellers in numbers and revenue, ranked in order:

Systems	Revenue
Apple IIe	IBM-PC
IBM-PC	IBM-XT
Apple Macintosh	Apple IIe
IBM-XT	Apple Macintosh
Compaq	Compaq
IBM PCjr	Compaq Plus
KayPro II	IBM PCjr
Compaq Plus	Apple Lisa
TI Professional	TI Professional
Epson QX-10	Apple III

Six out of the top 10 systems are IBM-PC or IBM-PC compatible systems, and two (KayPro and Epson) have limited compatibility as options. The only systems without any PC compatibility are Apple's.

What does advertising cost?

The Association of National Advertisers reported that last year IBM spent over $24 million on advertising its PCs. Since IBM shipped an estimated 450,000 systems last year, that works out to about $54 per system. $16 million was spent on TV. By contrast, Apple is reported to have spent $14.2 million, and shipped 637,000 systems, spending about $22 per system. About $6.5 million was spent on TV.

Quotation of the Month

"We are in a technology industry where promotion is more important than technology. The industry will spend over $600 million, and probably closer to $750 million, to promote their products . . . and, distribution is also more important than technology."

John Roach
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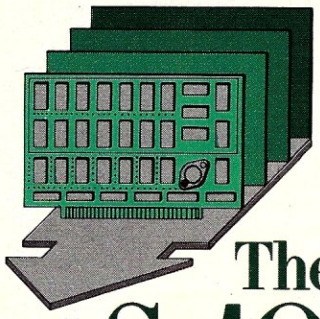

The S-100 Bus

The S-100 philosophy, and some thoughts on the MWRT signal

by Dave Hardy

It's hard to believe it, but the S-100 bus is nearly 10 years old! Although it has seen many changes, including upgrading for 16-bit processors, multiple CPUs, and standardization by the IEEE, the S-100 bus is still here, and its reasons for being here remain unchanged.

Being a hardcore S-100 user, it never occurred to me that there is now a whole new generation of computer users who have never even seen an S-100 computer. But, in the last several months, I have received dozens of letters from people who have just discovered S-100, especially in multiple processor environments, and who have written asking for advice or information about S-100 machines. Most of these people are amazed that the standard exists, and wonder why they haven't seen more about it.

In a (less than monumental) effort to help these readers understand the reasons for the S-100 bus, and how it came to be what it is, a quick review of the history of the S-100 bus is in order.

Way back in early 1975 (yes, some people *do* remember that long ago, even in the computer industry), *Popular Electronics* magazine (now called *Computers and Electronics*) published a "do it yourself" article for an inexpensive home computer based on the new Intel 8080 microprocessor. The article described a kit sold by a company called Micro Instrumentation and Telemetry Systems (soon to be called MITS). The machine itself, called the Altair computer, caught on instantly, selling in huge quantities.

The Altair was a pretty strange little machine by 1975 standards. It had lots of empty slots for plug-in boards, and had a bus that was based on 100-pin connectors that MITS chose because it got a good deal on them as surplus. (So much for the theory that the 100-pin bus was a stroke of engineering genius!) Cleverly enough, MITS called it the Altair bus. Each plug-in card contained its own on-board power regulators to minimize power supply problems and keep the cost of the machine's basic power supply as low as possible. With on-board power regulation, the basic supply needed to provide only raw 8 volts, 16 volts, and -16 volts to the 100-pin bus, which could be done quite inexpensively. Because there were so many expansion slots, lots of goodies could be plugged into the machine with minimum expense and hassle, so the machine was immediately useful for many different purposes.

Another company, called IMS Associates, Inc., decided to make a similar machine called the I-8080 that used the same bus as the Altair. It was really at this point that the multivendor S-100 bus was born. Soon after, the "Standard 100" bus (called S-100 for short) was being supported by hundreds of manufacturers, each with its own unique, but compatible, plug-in circuit board.

Actually, the boards were mostly, but not completely, compatible. There were many conflicts, especially in some of the stickier design areas, like timing for dynamic RAM boards, and the use of undefined lines in the S-100 bus. At first, the S-100 user was left to his own resources to rectify these incompatibilities. Although manufacturers tried to help the end users (somewhere between 1975 and 1977, computer hobbyists became "end users" according to the sales literature of that time), the versatility of the S-100 bus was becoming its albatross. If "mix and match" S-100 boards couldn't be made to work in a single S-100 machine, then the whole purpose of the S-100 bus was nullified.

Enter the IEEE. In 1978, several of the more prominent S-100 manufacturers, along with many other S-100 designers, submitted a proposal to the IEEE for a standardized S-100 bus. The IEEE set up an S-100 standards committee, and in July of 1979, the world first saw the proposed new S-100 standard, called "IEEE task 696."

In 1982, the proposed standard was adopted, and a much-changed S-100 bus was released. So improved was the IEEE-696 bus that, even today, most people are not aware of all of its capabilities. The IEEE-696/S-100 bus now supports 24-bit addressing and true 16-bit operations. It readily allows up to 16 processors on the same bus at once, and is versatile enough to work with almost any microprocessor. The S-100 bus is truly the most versatile microcomputer bus available today, and it has the added advantage of being precisely defined by IEEE-696.

Letters

I've had many inquiries in the last few months about the reason for the MWRT signal, and why it is not always generated by the CPU board. MWRT is just the simple memory write strobe that is available on the S-100 bus pin 68. It is defined as the product of the Processor Write signal (pWR*) logically ANDed with the inverted Status Output (sOUT) signal. The equation is

```
MWRT=pWR . - sOUT
```

and it just means that whenever the pro-

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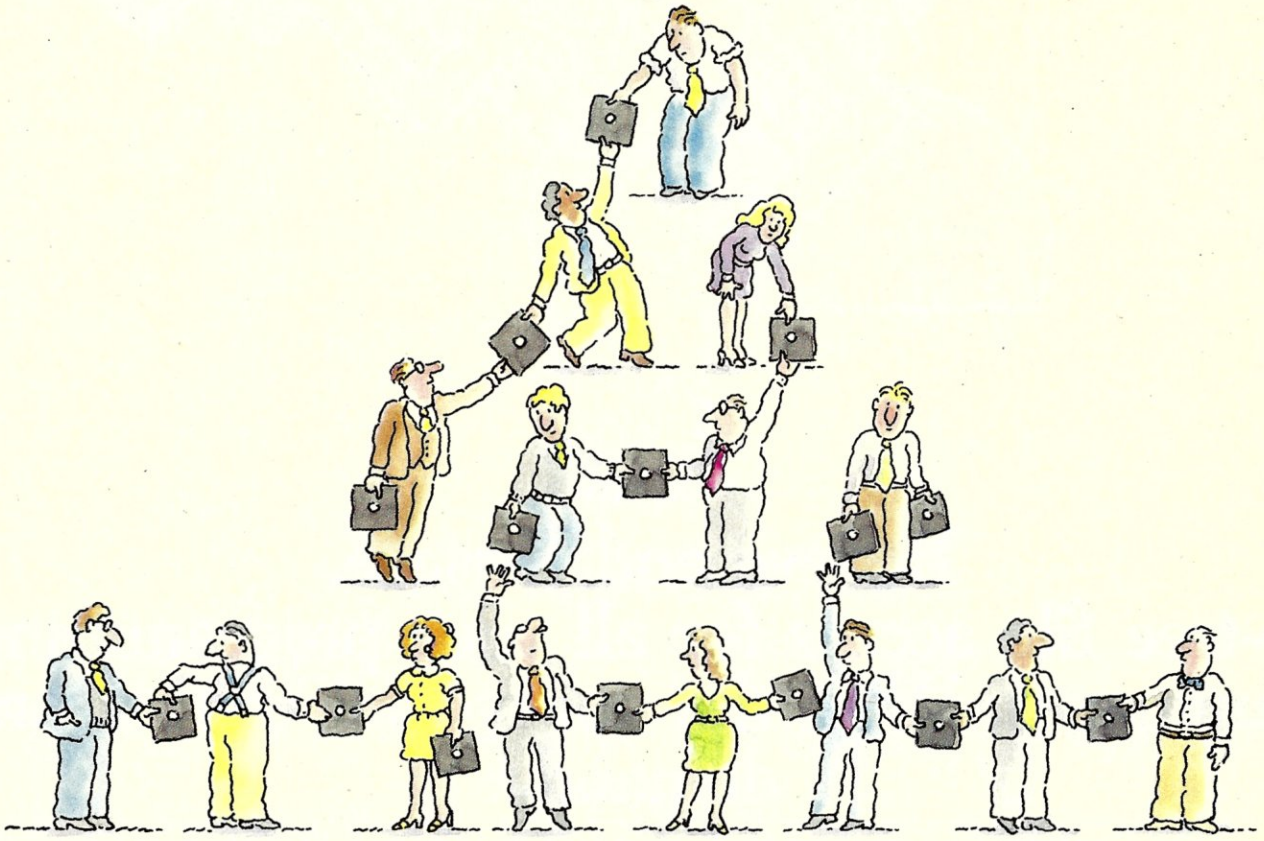

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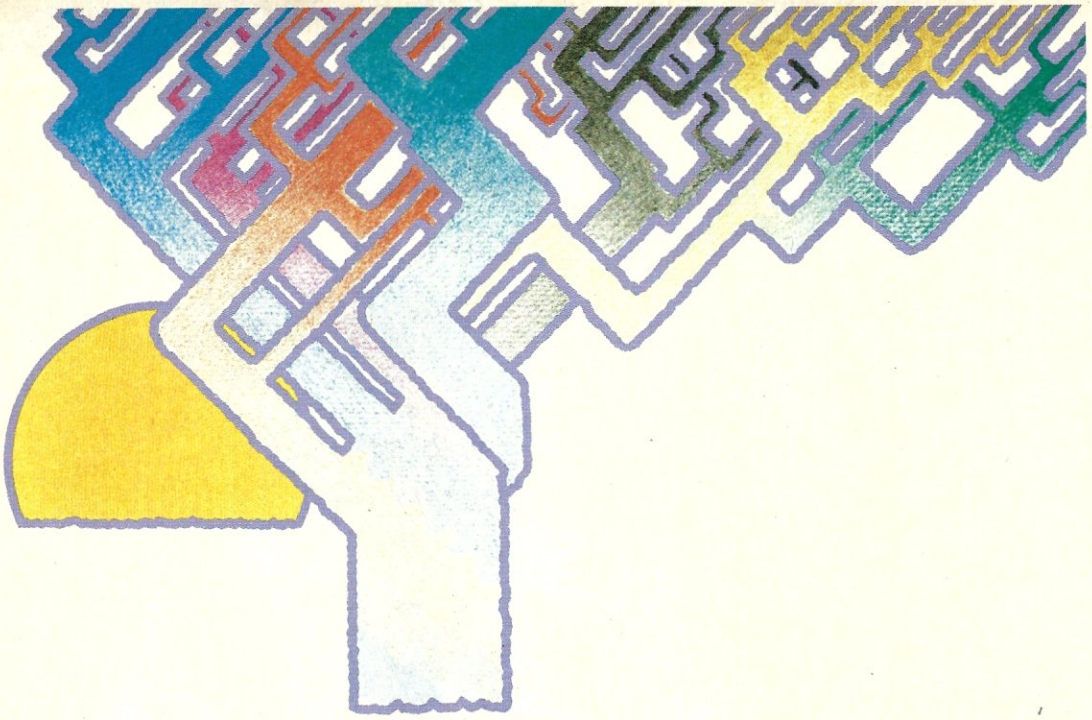

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S-100 Bus

Continued from page 12

cessor is performing a write (pWR*) to a memory address, not to a port address (-sOUT), the MWRT signal will be true.

The confusion about MWRT seems to come from the fact that it is not always generated on the CPU board, which is where you would expect to find it. In fact, the IEEE-696 standard doesn't care where it is generated, as long as it is generated properly, and only by a single source in the system. In many older S-100 systems (most notably IMSAI), the MWRT signal is generated by the front panel. Many plug-in S-100 memory boards have an optional circuit that can be enabled to generate MWRT in case the system has no other way to do it. In fact, many S-100 systems have two or three boards that are capable of generating MWRT. The trick, of course, is to just use one. The machine doesn't care which board is generating MWRT, it only cares that MWRT is available on the bus. By the way, MWRT should always be available on the bus; it should *not* be disabled by the Status or Control Output Disable signals SDSB* or CDSB*.

More confusion

More troubles are caused when MWRT is confused with sMEMR. MWRT, as I mentioned above, is a simple memory write strobe. sMEMR is a status signal from the bus master that is true whenever a memory read is being performed. Perhaps the reason that these signals are so often confused is that their names are so similar. Obviously, their functions are not. In addition, on some older CPU boards, sMEMR is sometimes improperly derived, which will cause the system to act improperly with certain IEEE-696 boards. I recall one case in particular where a (now defunct) manufacturer's S-100 board set actually did not use the sMEMR signal that it placed on the bus, and so the manufacturer never knew that its sMEMR signal was improper. Naturally, its customers (we hope) eventually found and cured the problem...

Flashing lights

I have received several notes from readers who are interested in buying an S-100 machine with a front panel. Although front panels are becoming rather scarce, they are still available. If you want to build your own, previous "S-100 Bus" columns and *Microsystems* articles have documented several circuits that you could build to make an IEEE-696 compatible front panel, including a RUN/STOP switch, single-stepper, address and data indicators, and even address and data traps. Or, if you don't want to do it yourself, IMSAI I-8080s may still be found at most computer hobbyist swap shows or flea markets (the IMSAI Corporation is no longer in business).

If you do a lot of hardware work, a front panel is a very handy thing to have. But unless you build your own, or modify someone else's, you may be sacrificing IEEE-696 compatibility. Be very careful, if you plan to buy a frame with a front panel, to find out what modifications you would have to do in order to make your own boards work in it. An S-100 frame made by Ithaca Intersystems is equipped with a terminated motherboard and front panel that are fully IEEE-696-compatible. It was expensive and may no longer be available from Ithaca Intersystems, but a used one would be a good bargain because the front panel has an outstanding set of test points and hardware debugging features.

This column is intended as a forum on S-100 bus topics. Readers are encouraged to send in questions on the S-100 bus, which I will attempt to answer. Please write to: Dave Hardy, 736 Notre Dame, Grosse Pointe, MI 48203.

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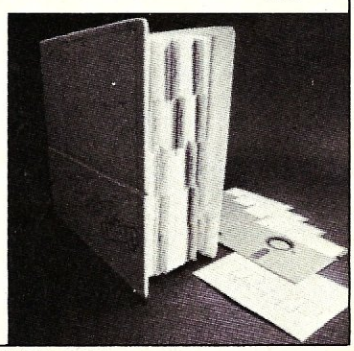

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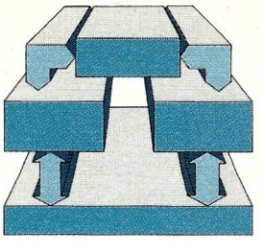

The UNIX File

Where to find key points on using UNIX; a plea for a wider range of UNIX topics

by Ian Darwin

Here's a look at another UNIX book, an open letter to the publishing industry about UNIX books, and comments on chip production and chip design for UNIX systems.

A Practical Guide to the UNIX System

Mark Sobell's *A Practical Guide to the UNIX System* (Benjamin/Cummings, Menlo Park, CA; 1984; ISBN 0-8053-8910-5, 428 pages) is a good way to learn some of the key points about using the UNIX system for certain tasks. The book is "for people with some computer experience but little or no experience with the UNIX system." Professionally produced and neatly typeset, the book offers lots of information about UNIX. However, the book does appear not to have been typeset directly from UNIX; there are few clues, but see the examples at the middle of page 178 and the top of page 190 which have obviously been re-keyboarded since being run.

Presumably, books about UNIX are prepared using UNIX—if not, the author's belief in UNIX needs reinforcement. I don't know why some publishers insist on retyping books when others are quite willing to accept them in machine-readable form. The modern typesetting machine is just a computer with some lenses and typefaces attached, so it should be possible to move files to it by disk or wire feed faster than by retyping. Converting *nroff* to WordStar and vice versa is rather easy; converting *nroff* to another typesetting system should be no harder. I'll be adapting my *nrws* to another system soon (it currently converts limited *nroff* commands to WordStar). All this code will be ready for release soon—you'll read about it here first!

Like many manuals on UNIX, Sobell's *Guide* is divided into two parts: expository and reference. Where it differs somewhat is that fully 40% of the book is given over to reference material. But the reference section (Part 2 of the book) is more than just a rewording of the standard UNIX 'man' pages. The descriptions of 60 or so common commands are considerably more detailed than those in other books. And there are examples for all of them. A few of these could have been done better or differently, but the great majority are fine.

In Part II, some of the 'man page' descriptions also have 'notes' sections, "some important and others merely interesting," describing unusual attributes of the command, availability information, etc. One to quibble with would be the *at* command, in which the examples strongly imply that you must put the simplest of commands into a file on disk in order to have *at* run them. In fact, *at* will quite happily read from the standard input (usually the terminal), so that one-time things such as the first example Sobell uses are often better done by typing the *at* command, and then the command you want executed, and an EOF, rather than putting it into a file.

Why do I dwell on such a small point? Because UNIX really is an easy-to-use system, despite the claims of certain 'experts'. And books which purport to show people how to use the system should not introduce unnecessary complications such as making you go into the editor to create a one-line file when you can just type the one line at the *at* command.

Back in Part I, we find chapters on the usual topics such as 'Getting Started', the utilities, the file system structure, the shell, editing, and *nroff/troff*. The book gives extended coverage to the *vi* editor, the Bourne shell as a programming language, and the C shell. There are several appendices, including ones on Regular Expressions and XENIX.

nroff is a powerful formatting tool, although not an interactive one. This chapter in Sobell's *Guide* discusses most of the features of this formatter and the *-ms* macro package. Examples of input and output are given, so that you can see what input produces what output.

There are many subtleties which cannot be explained in 40 or so pages; for these a book dedicated to just *nroff* would be called for (see below). Sobell's explanation carries most of the important topics needed to format short documents using *nroff*. The *vi* editor gets a full chapter.

Now as you regular readers know, I'm not a big fan of *vi*. I object to its complexity—some of which may underlie the oft-heard complaint that "UNIX is cryptic." Certainly *vi* is cryptic. By contrast, the *ed* editor gets only six pages. But *ed* has a regularity which *vi* will never have, so that you can learn patterns of techniques with *ed* while *vi* requires a large amount of memorization.

The Bourne Shell deserves coverage as a programming language, since it is at once easy to learn and very "high level." Some people consider it useful as an introductory computer programming language. The chapter on this important topic touches all the bases, although again, some of the examples are a little perfunctory. Each example

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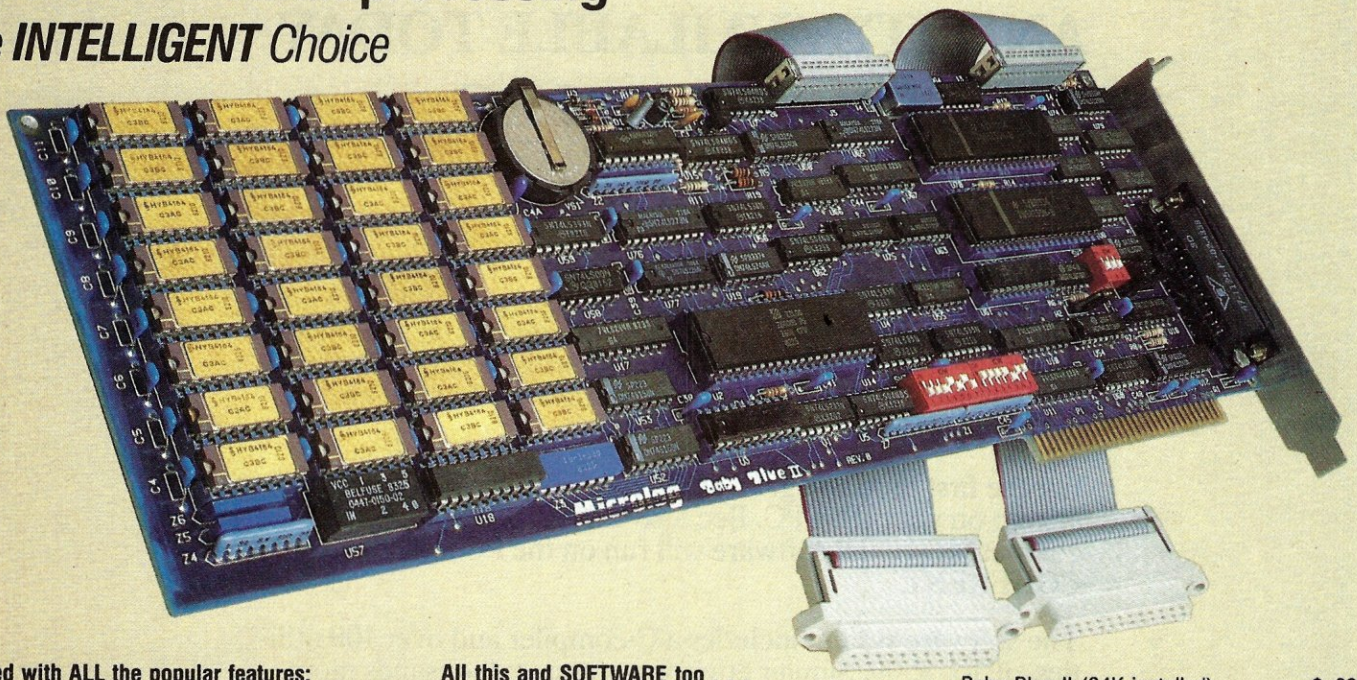

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UNIX File

Continued from page 18

shows only one significant function. Some larger, real-world examples of "putting it all together" would have given this chapter a sense of completeness. Also missing here is the emphasis on using Bourne shell programming capabilities interactively—see the comments on *at* above, which apply here as well.

The back cover claims that all "the important versions of the UNIX system are covered: Bell Labs Versions 6, 7, System III, Berkeley UNIX (BSD), Xenix." But Version 6 lacks the entire 'environment variable' structure, a fact you wouldn't find out by reading Sobell's description of this topic. And System III has a *ps* command with quite different options from that of Version 7 and 4BSD; again, you'd not know this by reading Sobell. However, as I said a few months ago, there is enough commonality among these systems that you can get by with minor adjustments.

The appendix on XENIX is wonderful. There has been a tendency in the past to consider XENIX a separate system, so that a book could be re-marketed by changing all occurences of the word 'UNIX' to 'XENIX' and adding a few paragraphs on the XENIX extensions. Sobell has proved that this marketing gimmick is unnecessary, that the differences between UNIX and XENIX can be explained briefly. Incidentally, the list of books in this series includes Sobell, *A Practical Guide to XENIX* (1984) and Sobell, *A Practical Guide to System V* (1985).

The appendix on Regular Expressions looks good, too. Regular Expressions dominate UNIX, as users know, and are one of the attributes that give UNIX its high degree of regularity (so to speak) and predictability (an attribute of overwhelming import when considering the 'ease of use' of any system). Regular Expressions (REs for short) are used in the editors, *sed*, *awk*, *grep* (which stands for g/RE/p, an editor construct), and several other places *including filename wild-carding* with some variations in syntax. Sobell doesn't mention filename expansion in his discussion on REs; probably, most UNIX users are unaware (as I was for quite some time) that the idea of the RE comes from theoretical mathematics and computer science; UNIX has simply implemented the idea very well, and with several varieties of syntax.

My theory is that, back when the UNIXverse was green, the filename matching had to be done using '?' instead of '.' as the single-character match, since many people wanted to use '.' in filenames at a time when '.' was already entrenched as the editor's single-character matcher. But it's worth remembering that such things as character-class matching work across the UNIX system, from the editors to *sed* to *grep* to the shell's filename matching.

All in all, Sobell's *A Practical Guide to the UNIX System* rates quite highly. There are some quibbles—as with most any book on such a variety of topics—but the overall effect is good. A useful, well-done introductory UNIX book.

Publishers can choose winners by avoiding manuscripts that are too close in topic to existing books on UNIX.

Enough is enough

This is an open letter to book manuscript buyers everywhere. As viewed by themselves, book buyers are the people who keep book publishers afloat by buying the winning manuscripts and rejecting the duds. Buyers may be seen in less salutory lights by book authors, editors, and a few others. Their job, at any rate, is to choose winning manuscripts. The winners are those that will sell to the public, or to some defined market segment.

One way to choose winners is to avoid manuscripts that are too close in topic, quality and coverage to existing competing books. You need look no further than the CP/M shelf of a large computer book store to convince yourself that it is possible to over-book a particular system. To have too many books on the same narrow topic hurts everybody. The consumer is flustered by too much choice. The author is hurt by competitive sales, resulting in reduced royalties. The publisher loses out the same way.

Now, am I calling on governments to regulate selection of books? Absolutely not!! Instead, I hereby call on book manuscript buyers everywhere to exercise a little foresight. That's all I ask. There are already several more-than-adequate books which introduce people to the UNIX system. I've reviewed quite a few of them in this very column.

What's needed now—both by consumers and by publishers—is, in my humble opinion, not another introductory UNIX book that is 5% better, or 3% shorter, or 7% glossier, than the competition. What's needed instead is—new topics. New topics for UNIX books—and every manuscript buyer knows that UNIX is hot—are easily thought of. Here are a few—not so that authors will use them, but to give you an idea of the range of possibilities.

The obvious ones include: 'Word Processing with UNIX' (in preparation, author is Morris Krieger); 'Systems Programming with UNIX' (done well, see Kernighan and Pike; *The UNIX Programming Environment*); 'Using Spreadsheets with UNIX' (done by Donald Beil for the Horizon spreadsheet); 'UNIX System Administration' (not done as a full book yet, as far as I know); 'Teaching UNIX' or 'Teaching with UNIX' (ditto); 'Writing Compilers using UNIX Tools' (taught as a course, not yet a textbook?); or maybe 'Writing about UNIX' (oh, let's forget this one. Might mean competition for me. How about 'Writing with UNIX' instead?)

Topics which might not be so good are: 'UNIX for Business' (since the businessman's view of UNIX is not substantially different from any other user's—all realistic people view the computer as a tool, or an appliance, not a panacea); a guide to 'XENIX' made by changing all 'UNIX' to 'XENIX' (see above); or 'UNIX for idiots' (since to use UNIX as UNIX you can't be a chimp, and to use UNIX as a push-button box you're not using UNIX as UNIX).

Well, the possibilities are on the table. You buyers and authors can submerge each other in a puddle of ticky-tacky all-alike 'Introduction to UNIX' books. Or you can swim in a healthy stream of books on diverse topics about UNIX. Which will it be?

The chips are down?

National Semiconductor has been having serious problems in producing working 32032 microprocessor and support chips in quantity at production speeds. It remains to be seen how this will impact system developers, as most current designs seem to use the 32016 (née 16032) chip, which is a little more stable; its bugs can be worked around. [And rumor has it that most of the

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UNIX File

Continued from page 21

32032 design team has left National Semiconductor.]

Meanwhile, Intel may finally be entering the 1970's with their chip design. In *Digital Research News,* Volume 4, Number 3, Rick Deutsch (Intel's program manager for UNIX System V) is quoted as saying: "The 80286 helps prevent computers from crashing as a result of user error" since it has memory management. "Also, users cannot enter the kernel of the operating system as they can with other chips."

Well, I'm glad to see Intel finally realising the importance of memory protection. But let's not pretend we just invented it last week. The PDP-11 family (on which UNIX was developed) had memory management since the PDP-11/45, made in the early 1970's, and the LSI-11 chipset (microsystem version of the PDP-11) has had memory management since the mid-1970's, as have all reasonable machines made since then. Motorola's 68000 family has long included a memory management chip, as has National's 32032 family. Can those mysterious "other chips" alluded to be any other than Intel's own 8086 and 8088?

And there's more. In the same issue of *DR News*, the claim is made that "DR Fortran-77 incorporates a new method of developing compilers, called the common back-end technology. The technology was developed by Digital Research and speeds the implementation of compilers for different types of microprocessors. . . ." Well, again, I'm glad to see that Digital Research getting around to taking advantage of current trends, but to claim that they invented the use of common back ends for compilers is absurd. They may have developed some particular software (i.e., their compilers), but common back ends have been in use for years on Digital's VAX, on UNIX systems of many types, and elsewhere.

Please feel free to write in with questions or comments. Addresses for regular mail and electronic mail are given below. I can't always answer immediately, but I will get back to you. And I'm always glad to hear from readers with comments either on the column itself or on their reactions to particular UNIX systems or products.

If you have comments or questions about UNIX or this column, please to write to Ian Darwin, Box 603, Station F, Toronto, Ontario, Canada M4Y 2L8.

If you have UNIX mail access to the UUCP network, you may contact me at **"ihnp4!darwin!ian".**

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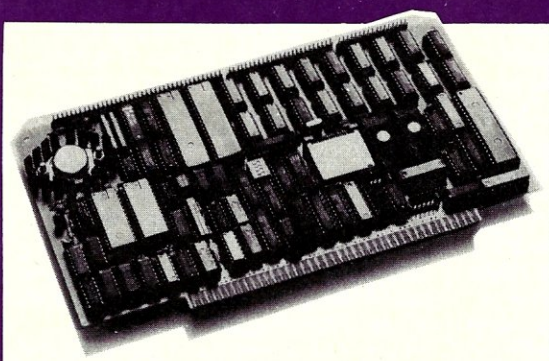

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CIRCLE 216 ON READER SERVICE CARD

The MS-DOS Window

Finding faults: How to spot trouble in your PC

by Hank Kee

The driver of an automobile is trained from the first to become alert to potential problems by periodically glancing at the dashboard. You almost automatically keep an eye on the fuel gauge and are soothed by the absence of red lights indicating low oil pressure or motor overheating. As you gain experience, you become alert to less obvious symptoms of trouble, such as knocking or sluggishness, mushiness in the brake system, or a tendency for the motor to stall when idling. If you have read one of the many books on automobile servicing, you may be able to remedy those problems within the range of your knowledge and the tools available—the alternative is to take the car back to the authorized dealer for repair.

What went wrong with it?

The situation is much the same with a computer, but because the computer is a more complex system than an automobile, the average user is less ready to dive into the books for the necessary information. Our culture is automobile-minded, but not yet computer-minded. Since it is not a simple matter to take your IBM PC to the nearest IBM Product Center for repair, and since when you do so they'll certainly ask questions about what kind of problem you experienced, it is important that every computer user learn the basics of how to isolate the problem to a particular part of the system. It's especially important if you have add-on boards, because the IBM Product Center won't service boards or peripherals made by other vendors. Of course, one can always buy from the local computer store, including only what the dealer sells, so that one can expect full maintenance from that sole source.

Diagnostic programs

IBM supplies minimal diagnostics with the PC to assist the user in case of trouble. Unfortunately, when there is a problem the diagnostic messages are very cryptic. The diagnoses of system problems are functional but have not been well supported—most of the pertinent information is buried in the Technical Reference Manual in the form of program code. The overall documentation needs considerable improvement.

However, there are other ways of diagnosing actual or incipient problems and isolating the cause to a specific part of your system. Once that has been done, the fix will be much easier and less time-consuming both for you (if it's something simple) and for the dealer (if it requires parts).

Beeeeeeep beep beep

When the IBM PC system is powered up, a series of self-test diagnostics is performed under control of the ROM monitor. At the end of this cold-boot system check, a single *beep* is sounded to indicate "system OK". You may not realize that there can also be a long beep followed by two short beeps. Because nothing is said about this in the user's manual, you may just scratch your head for a moment, think nothing more of it, and continue processing.

Well, one long and two short beeps means that the video RAM test detected a read/write error during initialization. This can occur with either the monochrome or the color graphics video board. It's one thing to know what the problem may be, but what does one do with this information? Apparently this is not considered a critical problem, since the system does not lock up and processing continues.

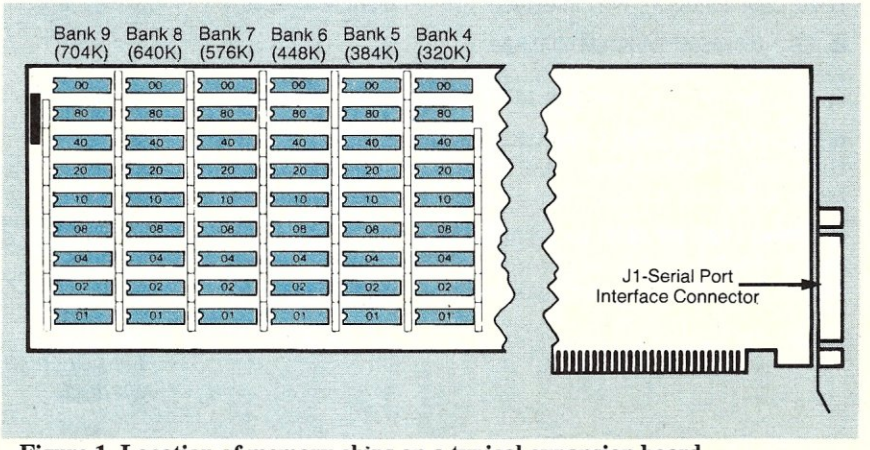

Figure 1. Location of memory chips on a typical expansion board.

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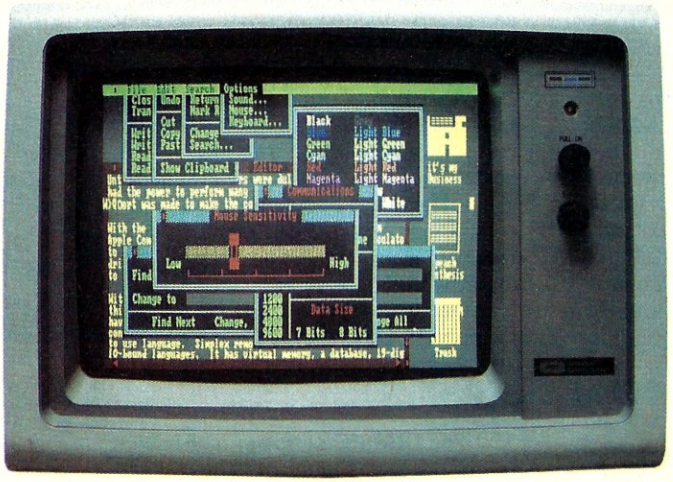

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CIRCLE 21 ON READER SERVICE CARD

MS-DOS Window

Continued from page 24

Parity 1 - parity 2

A ROM test that does lock up the system if it finds an error is the one that tests PARITY 1 and PARITY 2. Parity 1 refers to memory parity on the system board. By sizing down memory and replacing the memory row by row, it is possible to isolate the offending chip. Of course if the memory chips are soldered onto the system board instead of being inserted into DIP sockets, this would be a very difficult task. Parity 2 refers to an error on the I/O check lines. This normally occurs only if there is additional memory on auxiliary boards.

But there is a better way of finding the bad chip. Before the PARITY 1/2 message appears, a four-digit number, followed by "Memory Error 201" will flash on the screen—it remains only for only about 2 seconds, so you keep your eyes peeled. The first digit indicates the 64K bank in which the error occurred; on a PC-1, Bank 0 is on the system board and the remaining banks are on your memory expansion card. If you have a PC-2 with 256K of on-board memory, Banks 0 through 3 are on the system board and Banks 4 through 9 on the expansion card. On the system board (and on most expansion cards) bank numbers increase from rear to front.

The second of the four error digits should be ignored. The last two digits indicate which chip within the bank is in error: 00 is the parity bit at the left of the system board (Figure 1) or at the top of the expansion card (Figure 2); the data bits (indicated by 80, 40, 20, 10, 08, 04, 02, or 01) are located in order from left (top) to right (bottom) of the bank. If the 3rd and 4th digits do not match any of the above values, you probably have errors relating to more than one chip.

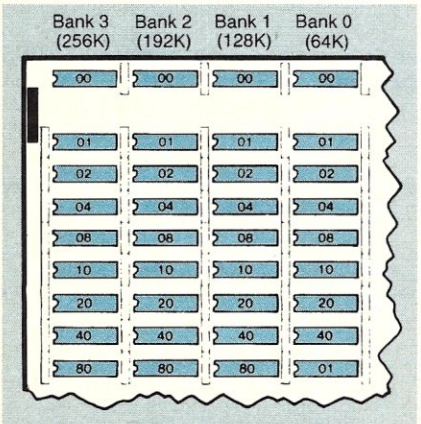

Figure 2. System memory chips.

This could be due to multiple bad chips, but might also be due to incorrect switch settings or (if the system was previously working) a displaced expansion card or dirty edge connector.

A common misconception is the idea that the memory is good if it passes a memory test. The various memory diagnostic tests can only tell you they didn't *find* a problem. It does not mean the memory is totally error-free, because the test may not be sophisticated enough to detect some of the more subtle memory errors. Parity failure can mean that the information in a memory location has been corrupted because of some gross error such as a bit that does not change state properly. In that case you would probably also get a message indicating a read or write error. But it can also be due to a memory chip that has marginal timing tolerances and is not fast enough during the refresh cycle.

A memory fault due to slow chips may not necessarily manifest itself in memory speed tests. Sometimes it will be detected only by a slow-running program. If you get occasional parity errors, it may be that your memory chips barely meet system requirement levels, and it would be wise to install faster chips. Most hobbyists prefer to use 150 ns memory chips on the IBM PC; these give an ample speed margin.

ROM

The IBM PC performs a checksum test of the ROM monitor. The correct checksum for the ROM is included on the ROM itself. Thus, a checksum of zero is required; otherwise the diagnostic message "ROM" will appear on the screen and the the system will then lock up. If the ROM has not been modified, this message means the ROM is defective. If you do modify or customize the ROM monitor to meet your individual requirements, make sure the checksum value has also been modified.

Diagnostics

The diagnostics provided by IBM are reasonably acceptable although by no means comprehensive. However, many people are not aware that the assignment of numbers to the list of equipment corresponds directly to the messages that may appear on the upper left-hand corner of the screen during system initialization. The complete list is shown in Table 1.

Table 1. Diagnostic routine numbers.

Device ID	Device name
1xx	main system board
2xx	memory
3xx	keyboard
4xx	monochrome or parallel printer adapter
5xx	color graphics adapter
6xx	diskette adapter
7xx	8087 co-processor
8xx	-
9xx	1st parallel printer adapter
10xx	2nd parallel printer adapter
11xx	1st asynchronous communications adapter
12xx	2nd asynchronous communications adapter
13xx	game adapter
14xx	printer test
15xx	SDLC communications adapter
16xx	-
17xx	fixed disk adapter
18xx	expansion I/O unit
19xx	(reserved for tape back-up unit)
20xx	bisychronous adapter
21xx	alternate bisynchronous adapter
xx	refer to the Technical Reference Manual for details of the diagnostic

Diskette verification

Although the IBM diagnostics are fairly complete in verifying the diskette drive, one additional test should be made: make sure that diskettes written on one of your drives are readable when they are placed in the other drive or in drives of other IBM PCs. This check is the simplest possible test of correct head alignment. To perform the check, first format a diskette on drive B: and fill it up with enough files to make sure that you are writing on the inner tracks. Label the diskettes as having been formatted and written on drive B:. Then do the same thing on drive A:. Now check to see that the A: diskette is readable on the B: drive and vice versa. If you have an XT, use the buddy system to check the output alignment of the single diskette drive.

I recently experienced recurring read errors on both drives with a large number of diskettes. The problem was isolated to the constant use of the same diskettes as work media. This constant use resulted in uniform wear and tear on the set of diskettes. The use of a poor grade of diskettes is often a contributing problem. To avoid this kind of problem, use a good grade of diskette (many people have reported having fewest errors

from Dysan or Maxell disks). And don't forget to make backups of important disks and to keep the backups regularly and frequently updated to correspond with the working disks.

Observation and common sense

Cultivate your powers of observation, and whenever there is a glitch in the system, make notes of *exactly* what you did during the moments before the glitch and what you saw on the screen or on other peripherals when the glitch occurred. Comparison of these observations with the normal course of events may provide valuable clues to the problem and the probable effect on the data you were processing.

Observations of this kind are essential in the case of a software bug. Whoever attacks the problem—whether it be an IBM technician or a knowledgeable friend—must be able to duplicate it in order to track it down and eliminate it. To do this he will need a *complete* description of what you did and what happened. Without the appropriate information, he probably won't be able to help you.

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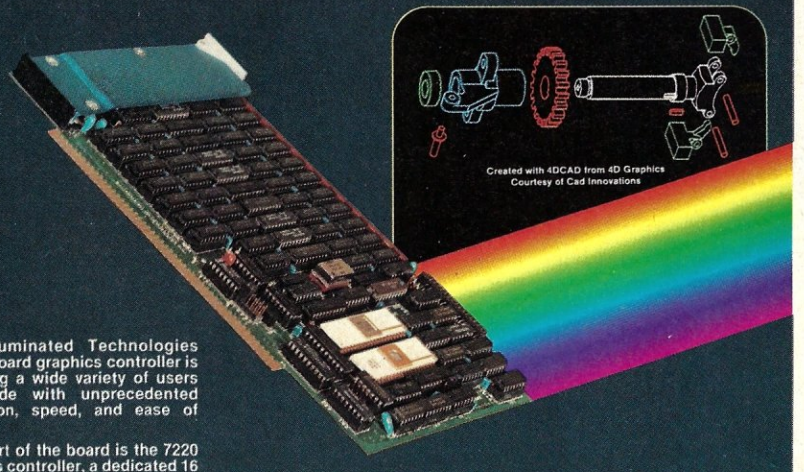

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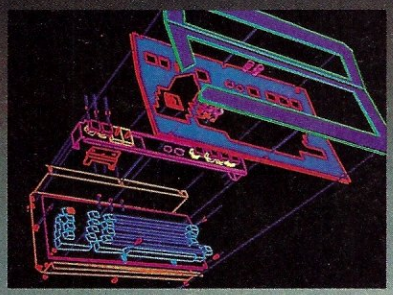

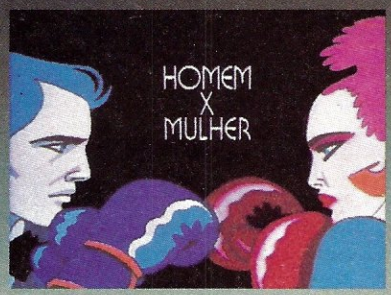

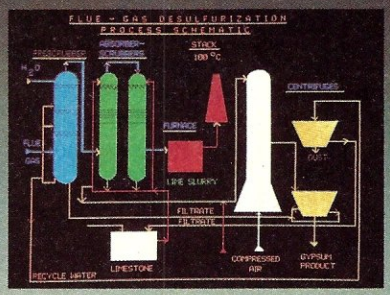

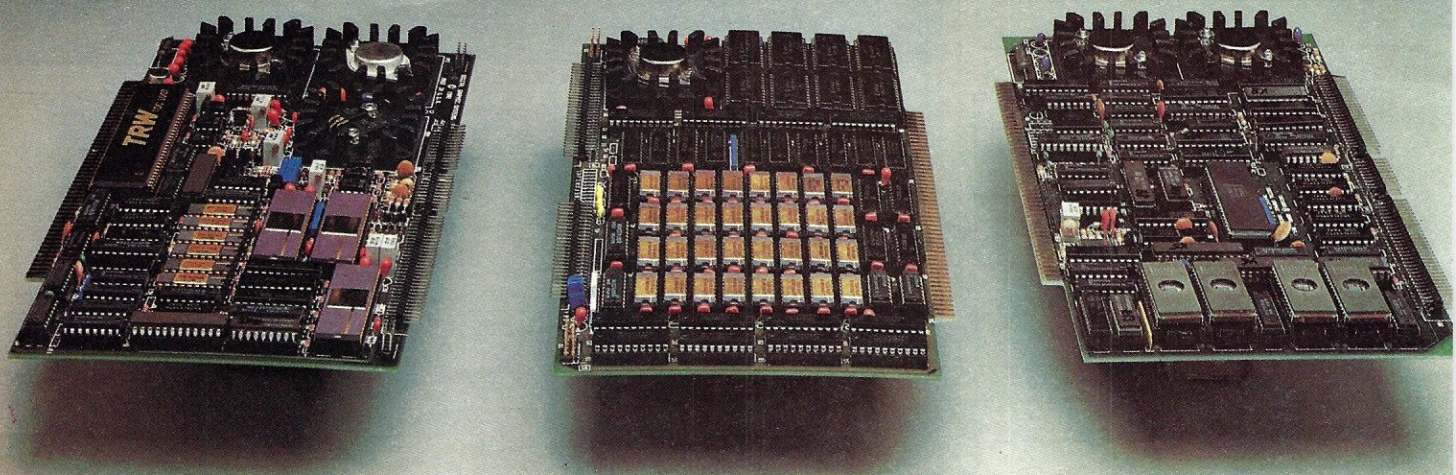

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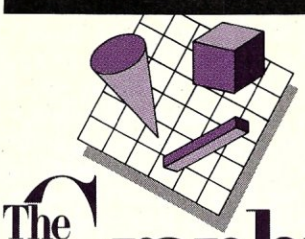

The Graphics Palette

The adventures of the direct hardware interface

by Dave McCune

The assembler programmer is the Indiana Jones of software. Physical ports and clocks and memory locations take the place of mountain peaks and caverns and dagger-wielding savages. Like Indiana Jones, the programmer's battle is often more exciting than the victory. The awesome mystery of directly interfacing with sinister hardware underlies the assembler programmer's special swagger.

Adventure for the sake of adventure may be fine for the movies and the ego, but try to sell that to the friendly investors who pay the application programmer's room and board. It is faster, though less exciting, to get to China on Pan Am than on a mysterious freighter. And it is faster (and more economical) to program most applications in a high-level language, with only an occasional assembler adventure when absolutely necessary.

Fortunately for the swagger of many graphics programmers, though, the adventures of the direct hardware interface are still unavoidable ingredients in graphics applications. The programmer is stuck with writing special, low-level code to drive each graphics device—a video screen, printer, plotter, etc.—used by an application. Unfortunately for investors and end-users, the fact that most graphics applications are very device-dependent has limited the market and increased the price of most graphics applications.

As described in this column last month, one proposed solution to the problem is the Graphical Kernel System (GKS), a uniform way for programmers to talk to a wide variety of graphics input and output devices. The need for a GKS-like standard has increased greatly during the past few years as high-performance video controllers and plotters have dropped in price. These affordable graphics devices provide a hardware base for inexpensive, microcomputer graphics applications. But with the plethora of devices comes the need for program portability. GKS solves part of the problem. At the July SIGGRAPH convention, GKS was a hot topic among microcomputer graphics vendors. GKS is currently under review by the American National Standards Institute (ANSI) and a standardized version of GKS will likely be adopted this year.

We examined GKS on an abstract plane last month. GKS consists of a large set of functions that the programmer can call to draw and manipulate graphics. This kernel of library functions must be accompanied by a set of device drivers for the specific hardware devices which the programmer wants to use. The interface between the GKS kernel and the hardware-specific drivers is now subject to another standardization effort. One proposed model is known as the Virtual Device Interface (VDI). The GKS programmer sends output to virtual devices called *workstations*, and VDI translates the GKS calls into uniform calls to specific drivers. Just as GKS makes it possible for applications programmers to write programs that are portable from one GKS system to another, so VDI enables system programmers to write device drivers that are independent of specific GKS implementations.

GKS implementations for large computer systems have existed for years. But only very recently have microcomputer graphics programmers been able to take advantage of GKS. One impressive implementation for the IBM PC is by Graphic Software Systems.

The GSS package consists of two packages: the *GSS Toolkit Kernel System* and the VDI-based *GSS-DRIVERS*. Just as most application programs are only as powerful as their I/O capabilities, so GKS is only as useful as the set of drivers available. The GSS set is quite good for a new implementation,

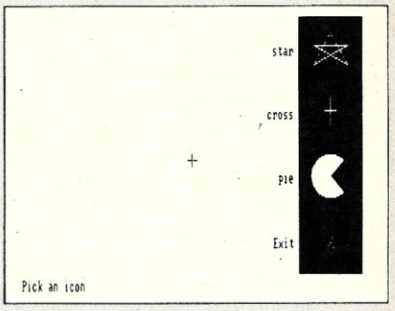

Figure 1. Icons created using GKS.

but it certainly needs to be expanded. The 29 drivers now supplied break down as follows:

Printers. 17 printers, ranging from dot-matrix to ink-jet.

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Video display. GSS is very weak here, supporting only the IBM color/graphics adapter in medium-res color and high-res black & white modes. None of the enhanced graphics adapters for the PC—Scion, Number Nine, Tecmar, Plantronics, Hercules, Amdek, etc.—are supported.

Continued from page 29

Mouse. The Summagraphics Summamouse is the only mouse device.

Tablets. The Koala Pad Touch Tablet and the Summagraphics Summatablet are supported.

Files. GSS has a driver for writing graphics to a disk file, called a Virtual Device Metafile (VDM) where the VDI defines functions, the VDM defines a logical way of encoding those functions for disk storage. The concept of the VDM can be found in the GKS standard; however, the spefications itself form a separate standard, appropriately called the VDM standard.

Recorders: The Samurai IMAGE 1 camera recorder is supported.

The GSS-DRIVERS package consists of two distinct pieces. First, all I/O requests from GKS applications programs pass through a VDI driver, called GSSVDI.SYS, which must be in the root directory of the boot disk and is called from CONFIG.SYS. The generic VDI driver in turn manages the second piece of the package, the hardware-specific device drivers.

When we start GSS GKS on the IBM PC, we first create a table which relates GKS workstation types to DOS logical names. For example, we might specify that GKS workstation type 1 is a DISPLAY device and that workstation type 2 is a PRINTER device. The DOS logical names are assigned to specific hardware device drivers by means of SET commands in the AUTOEXEC.BAT file on the boot disk. Consider the CONFIG.SYS file in Figure 2. When the system is booted, memory areas are created for each group. Each memory area is large enough to accommodate the largest driver in the group. The last driver in a group (IBMCO.SYS in group SCREEN above) is loaded and remains resident.

GSS divides its drivers into five types: DISPLAY, GIN (graphics input and output, which include TABLE and JOYSTIK (sic)), PRINTER, PLOTTER, and METAFILE. These type names are specific to GSS and are not standard GKS. When a GSS GKS application starts, it first maps the standard GKS workstation types (1 to n) to one of the GSS logical names. Note that this operation is non-standard GKS, and the function provided by GSS for this—INITIALIZE GKS—is the only non-standard GKS function in the entire GSS GKS repertoire.

From then on, when an application opens a workstation, the GSS driver knows which type of driver (DISPLAY, TABLET, etc.) it needs. The GSS VDI driver then loads the hardware driver.

The need for a GKS-like standard has increased greatly over the past few years.

Users may override this search and load process by setting DOS environment strings. I could, for example, enter

```
SET DISPLAY=IBMCO.SYS
```

to insure that the driver for medium resolution color graphics was used anytime the application used a workstation type which had been mapped to the GSS DISPLAY type. The extraordinary power of GSS device independence is demonstrated by these commands:

```
SET DISPLAY=OKID92.SYS
SET OKID92.SYS=LPT1
```

These commands redirect graphic output from the normal display device—probably a video screen—to an Okidata 92 dot-matrix printer. The same program that draws, say, a pie chart on the video screen now draws the chart on the Oki. Not a single line of source code had to be changed!

This example raises an important issue. Advocates of GKS sometimes exaggerate its device independence. In fact, a programmer using GKS is not freed entirely from worrying about how graphics will appear on different physical devices. As a crude example, imagine a GKS-produced advertisement for paint done for the IBM color/graphics adapter. If we were to send that output to an Okidata 92 it would only show up in black & white. The fact that graphics display in a predictable manner on devices of different capabilities does not mean that they display well on those devices.

Once the VDI driver and selected hardware drivers are loaded via the normal CONFIG.SYS mechanism, the system is ready to run GKS programs. GSS offers GKS in the form of a Toolkit, containing subroutine libraries for Fortran, Basic and C. Each library contains a full set of GKS functions.

The bulk of the GSS manual consists of descriptions of each function for each of the three supported languages. Another note of caution is in order here. For each GKS function and each of the three supported languages, GSS must define the specifics of how the function is called; i.e., the name of the subroutine in a particular language and the types and organization of arguments. This definition of how a particular language interfaces to GKS is called a language binding. For now, Fortran is the only language for which a standard binding exists. The Basic and C bindings are GSS inventions. Any other company that creates a GKS C binding may choose entirely different subroutine names or data types. Indeed, as work on standardized Basic and C bindings progresses, it is likely that the GSS version will have to be modified.

The Fortran binding requires Microsoft Fortran, the Basic binding requires the Microsoft Basic compiler, and C requires Lattice C, version 2.0 or later. In the applications program, the programmer simply calls one of the 130 or so available functions. As an example, the C function

```
g--pline (count, x--vertices,
        y--vertices)

    int count;
    float x--vertices[],
      y--vertices[];
```

draws a polyline, connecting the x,y coordinates in elements 0 to 'count' of the two arrays.

A sample program which draws icons on a display device and then allows the user to move a cross-hair and pick an icon is included with the GSS package. That program is printed as Listing 1. The icons as they appear

```
DEVICE=A:\DRIVERS\IBMBW.SYS   /GROUP:SCREEN
DEVICE=A:\DRIVERS\IBMCO.SYS   /GROUP:SCREEN
DEVICE=A:\DRIVERS\OKID92.SYS  /GROUP:PAPER
DEVICE=GSSVDI.SYS
```

Figure 2. A typical CONFIG.SYS setup

when output is sent to an Okidata 92 appear in Figure 1.

GSS GKS is an impressive implementation. It includes most of the common level 'mb' GKS functions, and then some. (A nice extra, for example, is the inclusion of 'Generalized Drawing Primitive,' with built-in bars, arc and circles.) GSS also supports segments, i.e., storage and manipulation of a set of primitives as one unit. Transformations may be applied to segments, making it quite easy to move, copy, erase and scale complex objects.

The GSS implementation is smart enough to detect and use the 8087 math coprocessor if present. Since GKS manipulates coordinate data as real-number fractions of a unit screen, the 8087 can speed graphics processing considerably.

There are some deficiencies, though. GSS does not support GKS attribute bundling, which would allow the system operator to define defaults for how each primitive—e.g., polyline—would appear on each workstation. In the GSS version, if you want to set different attributes for, say, polyline on each device, you have to reset the

Listing 1.

```
   /* PROGRAM COURTESY OF GRAPHIC SOFTWARE SYSTEMS              */
   /*    Sample pgm showing icon creation & use w/GSS GKS.     */
   /*    Output is directed to the DISPLAY device.             */
main()
{
   int err_fil, status, segnam, pickid;
   err_fil = initialize();     /* initialize Kernel System     */
   set_norm();                 /* set normalization transforms */
   set_attributes();           /* set primitive attributes     */
   out_prims();                /* output primitives to segment */
   gspck_mode(1,1,0,0);        /* set pick input dev to REQUEST*/
   gst_color(1);
   gst_align(0,0);
   for (;;) {                  /* lp until Exit icon selected  */
     g_text (10.0,10.0,"Pick an icon");
     for (;;) {                /* loop until get valid pick    */
        grq_pck (1, 1, &status, &segnam, &pickid);
        if (status == 1) {
           gst_color (0);      /* erase the text */
           g_text (10.0,10.0,"Pick an icon");
           gst_color (1);
           break;
        }
     }
     indicate (pickid);        /* indicate the icon selected */
     if (pickid == 400) break;
   }
   terminate(err_fil);         /* terminate Kernel System */
}
int initialize()               /* INITIALIZATION SUBR */
{
   extern double gini_gks();
   static int device[] = {1};
   int err_fil;
   double vernum;
   vernum = gini_gks (1, "DISPLAY", device);   /* set drivers */
   err_fil = creat ("errors",0644); /* use portable C libr fn */
   gopn_gks (err_fil, 5000);       /* open Kernel System       */
   gopn_wk (1, 0, device[0]);      /* open workstation # 1     */
   gact_wk (1);                    /* activate workstation # 1 */
   return (err_fil);
}
set_norm()       /* SUBR TO SET NORMALIZATION TRANSFORMATION &
                    DISPLAY SURFACE VIEWING AREA. */
{
   int errind,dcunit,mxxras,mxyras;
   float xdcmax,ydcmax,scale,xndc,yndc;
   errind = gqmax_disp (1,&dcunit,&xdcmax,&ydcmax,&mxxras,
                        &mxyras); /* get max dsply surface sz */
   /* calculate aspect ratio of display surface */
   scale = (xdcmax < ydcmax) ? ydcmax : xdcmax;
   xndc = xdcmax / scale;
   yndc = ydcmax / scale;
   gs_wind (2,0.0,100.0,0.0,100.0);        /* set world window */
   /* set world viewport & workstation window to same aspect  */
   /* ratio as display surface so will map to entire display  */
   gs_view (2,0.0,xndc,0.0,yndc);
   gswk_wind (1,0.0,xndc,0.0,yndc);
   /* set workstation viewport to entire display surface      */
   gswk_view (1,0.0,xdcmax,0.0,ydcmax);
   g_seltrn (2);                   /* select transformation 2  */
}
set_attributes()         /* SUBR TO SET CURRENT ATTRIBUTES     */
{
   gsl_color (0);        /* set color indices to background    */
   gsm_color (0);
   gsm_type (2);         /* set polymarker type to cross       */
   gsm_scale (3.0);      /* set polymarker scale factor to 3   */
   gsf_inter (1);        /* set fill area style to solid       */
   gsc_height (1.0);     /* set char ht to 1 world coordinate  */
   gst_align (3,3);      /* set text aligment to right, half   */
}
out_prims()              /* SUBR TO OUTPUT PRIMITIVES TO DSPLY */
{
   char datrec[1];
   static float xfray[] = 75.0,90.0};
   static float yfray[] = 15.0,95.0};
   static float xlray[] = 78.5,86.5,78.5,86.5,82.5,78.5};
   static float ylray[] = 80.0,86.0,86.0,80.0,90.0,80.0};
   static float xgray[] = 82.5,85.5,85.5};
   static float ygray[] = 45.0,50.0,40.0};
   static float xmray[] = 82.5};
   static float ymray[] = 65.5};
   static float xeray[] = 82.5};
   static float yeray[] = 25.0};
   gcreat_seg (10);                    /* create a segment      */
   g_gdp (2,xfray,yfray,1,0,datrec); /* output a solid bar      */
   gs_sdetec (10, 0);  /* set this segment's detectability...  */
   gcls_seg();                         /* ...to undetectable    */
   gcreat_seg (20);                    /* create another segmnt */
   gs_pickid (100);                    /* set pick id to 100    */
   g_pline (6,xlray,ylray);            /* output a polyline     */
   g_text (74.0,85.0,"star");          /* output icon identif'r */
   gs_pickid (200);                    /* set pick id to 200    */
   g_pmarker (1,xmray,ymray);          /* output a polymarker   */
   g_text (74.0,65.0,"cross");         /* output icon identif'r */
   gs_pickid (300);                    /* set pick id to 300    */
   gsf_color (0);  /* set fill'd color index to 0 for nxt gdp  */
   g_gdp (3,xgray,ygray,3,0,datrec); /* o'put fill'd pie slice*/
   g_text (74.0,45.0,"pie");           /* output icon identif'r */
   gs_pickid (400);                    /* set pick id to 400    */
   gsm_type (5);                       /* set marker type to 5  */
   g_pmarker (1,xeray,yeray);          /* output a polymarker   */
   g_text (74.0,25.0,"Exit");          /* output icon identif'r */
   gcls_seg();                         /* close second segment  */
}
indicate (pickid)   /* SUBR TO INDICATE WHICH ICON WAS PICKED */
int pickid;
{
   switch (pickid) {
      case 100: g_text (10.0,85.0,"Star picked");  break;
      case 200: g_text (10.0,65.0,"Cross picked"); break;
      case 300: g_text (10.0,45.0,"Pie picked");   break;
      case 400: g_text (10.0,25.0,"Exit");         break;
      default:  break;
   }
}
terminate(err_fil)          /* SUBR TO TERMINATE KERNEL SYSTEM */
int err_fil;
{
   gdct_wk (1);             /* deactivate workstation # 1 */
   gcls_wk (1);             /* close workstation # 1      */
   gcls_gks();              /* close Kernel System        */
   close (err_fil);         /* close the error file       */
}
```

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Palette

Continued from page 31

polyline attributes just before performing the output to each device.

GSS supports only 'request' and 'sample' (polled) input and does not allow event-driven (interrupt-driven) input. Thus, it is not possible to interrupt a GSS GKS program with more input unless the program explicitly checks for this input. While frequent sampling for input will suffice for most applications, the lack of event-driven interrupts could be a problem for some real-time graphics simulations.

GSS does not allow 'cell arrays,' a GKS primitive which allows a programmer to create a customized texture. The texture defined in the cell array is applied to the display almost like wallpaper.

Even though GSS provides only a subset of GKS, it is a large and very useful subset. Given the caveats above, along with the inherent limitations of GKS itself (e.g., no 3-D support), the GSS implementation may be the best graphics programming environment available on micros today. I certainly can't think of a better choice.

My only worry—and it is a serious worry—concerns the attitude at GSS towards smaller customers. GSS explicitly does not want to deal with end users. In fact, if you are not now in a league with Lotus or Mindset, then GSS would rather not deal with you. GSS sees its customers as being large OEMs or hardware vendors, with an occasional large end user ("like a big oil company, maybe," I was told). They are just not prepared—at least at this point—to gear up to provide support for a large number of end users. This is a shame, since I have only good things to say about my experience with GSS customer service. When I called, GSS knew I was a reviewer, so I can't say how they would react to a call from an independent applications programmer. Someone ought to explain to the folks at GSS that most of the good microcomputer graphics applications being done today are written by very small, pioneering companies.

GSS told me their product would be distributed and serviced by other companies. They suggested I contact Lattice, Inc. (developers of the well-known C compiler) if I wanted to buy a single copy of the GSS system. Indeed, one of the co-owners of Lattice told me they do sell the GSS library for $150 and the full set of drivers for $75, and that they will be providing support. Both GSS and Lattice were very cooperative in answering questions for this review.

However, software developers are potentially going to have a serious problem with what appears to be—at this point, at least—a medieval licensing policy for the drivers. When you write an application program using GSS, then whoever you sell the program to must be licensed to use the device drivers, which are supplied as individual .SYS files, one for each driver. If you are selling a program to more than one client (e.g, on the open market), Lattice will make special licensing arrangements. *[We support David's view that this is a medieval licensing policy—it has proven to be one that just can't be administered (at least in the micro environment), as evidenced by such language packages as DR's PL/I-80 and Microsoft's Basic compilers. Both these vendors—and, in fact, all other vendors we know of who had such policies—dropped the practice years ago. It was an interesting attempt at a method for gaining additional revenues that just didn't work. In all fairness to Lattice, they have an open licensing policy for all of the software they sell; in keeping with this, Lattice supports changing the GSS policy to require no additional licensing at all for the drivers above the original cost of the GSS package. It appears to be GSS that needs to be educated. On the other hand, it may simply be a confusion that has arisen between GSS, Lattice, and us in gathering the information—editor.]*

For the moment, GSS does not have much competition in the microcomputer GKS market (although two popular quasi-GKS implementations come to mind: Digital Research's GSX and Media Cybernetics' HALO). I know of only one other company preparing a substantial GKS implementation: Nova Graphics International. They currently offer a GKS Fortran binding for VAX, and their first C binding with PC peripheral drivers is due out shortly. Nova has assembled the best GKS tutorial and reference manual I've seen, and one can only hope their software is as complete and classy. Nova is certainly more interested than GSS in selling to and supporting smaller OEMs and independents. And they have no plans to cajole hardware manufacturers into paying to have Nova write drivers for peripherals. On the other hand, Nova, too, wants applications programmers to pay royalties on sales of all programs which use Nova GKS routines.

GKS on micros has certainly arrived, and GSS may be the best friend it ever had in its struggle to become a common standard. GSS has produced an extraodinary implementation of GKS. They even had the chutzpah to hire Peter Bono, the chairman of the ANSI committee that standardized GKS, as a

standard-bearer and proselyte. However, GSS may have at least *some* trouble increasing the list of drivers, given an odd marketing policy. Bill Merchant, Marketing Communications Manager at GSS, explained that GSS will write a driver for a new hardware peripheral only if the manufacturer pays GSS for the privilege. Merchant argues that the existence of a GSS GKS driver for a particular peripheral makes the peripheral much more attractive to system integrators. Given that GKS is still very uncommon on micros, that seems a bit like the tail wagging the dog. Indeed, when I asked if GSS had demanded that IBM pay to have a driver written for their color/graphics adapter, I was told IBM was "an exception." Unless either GSS becomes a billion-dollar powerhouse in the next year or they decide to allow many more "exceptions," I fear the list of supported drivers will remain at its present skeletal state. If only they were as friendly to their potentially largest market: small, independent graphics software companies.

[Without softening the impact of David's statements regarding his fears that GSS may have trouble increasing the list of drivers, the fact is, we feel this is an exciting enough product that GSS just may pull it off. You may not, at this point, want to run out and develop a major graphics system that depends on the GSS GKS implementation, but, if you are interested in graphics standards, the package is certainly worthwhile purchasing to learn about it, provided you have an IBM color adaptor or one of the compatibles. On the other hand, it looks as if some OEM agreements for drivers—especially, for display devices—may be in the offing. Check with Lattice to find out what drivers are currently available.

While checking this information, we cleared up some of the confusion regarding the licensing and pricing policies of GSS and Lattice: you can buy the package from Lattice (total, $225: $150 for the Toolkit Kernel System; $75 for GSS-DRIVERS). There are no additional licensing fees if you are selling an executable application package.—Editor]

Dave McCune, Proteus Group, Inc. 195 Garfield Pl., Brooklyn, NY 11215

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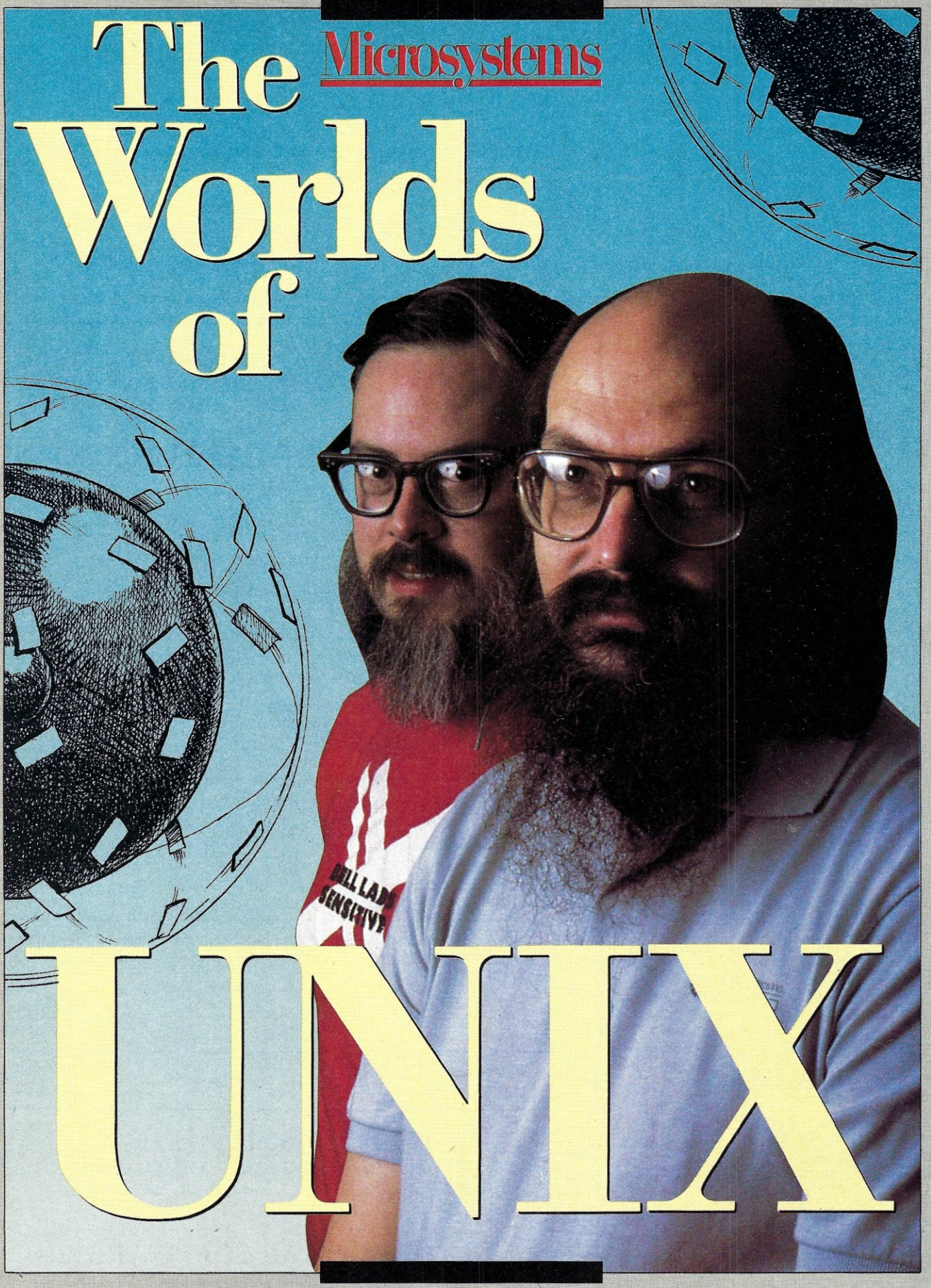
Microsystems

The Worlds of UNIX



Simply defined, an operating system is the software that manages the resources of a computer. It is the soul of the computer, the software that manages the time and the hardware, the two components of a computer's resources.

The primary element that provided the foundation for the rapid growth and penetration of micros into a large user base was the portability of the CP/M operating system. Yes, there are other elements that were important: the fact that micros were affordable, the fact that CP/M is relatively simple to understand and use, while still being powerful enough both to be used as a development system and to perform a wide range of very useful tasks for end users. But by far the most important single factor was its portability.

CP/M was designed as a modular operating system, in the sense that the *logical* portion of the operating system—the part that makes the decisions—is separated from the *physical* portion—the part that actually controls the hardware and is therefore specific to a particular machine. And it required only a relatively minor amount of system development to write the machine-specific portion for a particular machine in order to add that machine to the world of CP/M.

Thus, once a program was written under CP/M on one machine, it would run on virtually any other machine running CP/M. Even if there was machine-specific code, such as screen I/O or I/O to some other nonstandard peripheral (such as a modem), it generally required very little modification—sometimes it meant just running a one-time configuration program supplied by the author—to allow the program to run on different CP/M machines.

However, CP/M, in all its elegant simplicity, has a major flaw: it is so succinctly designed that it simply cannot handle the myriad of tasks—hardware as well as software—that are both required by today's needs and made possible by new hardware technology. There is, however, an operating system that shares the same basic philosophy of machine portability and still has the power to accommodate modern needs: UNIX.

UNIX does indeed appear to be fast approaching our world—the world of the micro system and software developer.

This issue is the first part of a special presentation on UNIX. In it, we highlight the evolution of UNIX and present reviews of a software implementation of UNIX, an affordable hardware system running System V, plus an extensive C-subroutine library package. We also offer the first of an ongoing series of personal views of UNIX by individuals experienced in using it.

UNIX was first publicly introduced in 1974 by Dennis Ritchie and Ken Thompson; but it was originally created by Ken Thompson in 1969, with Ritchie joining the effort very soon after its original creation, and M. D. McIlroy and J. F. Ossanna soon after that. Ritchie presents the history of the early evolution of UNIX, from 1969 to 1974, in "The Evolution of the UNIX Time-Sharing System," which we are reprinting in this issue verbatim from the original Springer-Verlag publication. Next month, we will focus on the development of UNIX since 1974, highlighted by an interview with Andrew D. Hall, the Director of the AT&T UNIX System Development Laboratory.

UNIX offers different groups the unity of an operating system born of the eclecticism of its users.

Of particular interest in Dennis' article are such things as his description of the desire to create "not just a good environment in which to do programming, but a system around which a fellowship could form" in order to encourage communication among programmers, as well as details about why and how some of the system design elements came about.

We learn, from Ritchie, about the evolution of UNIX from Multics, and about such system elements as the file structure, process control, I/O redirection, pipes, and the evolution of C from BCPL and B; and we learn how UNIX took on its modern form in 1973 when the system kernel was rewritten in C. It is particularly interesting to note that, despite the fact that UNIX was designed for a specific machine environment, the design was elegant enough to allow it to be made portable.

In the interview with Ritchie and Thompson, we learn more details about the evolution of UNIX—and we get a glimpse of Ritchie's and Thompson's personalities and how they interact. They describe the environment that gave impetus to the development of UNIX, talk a little more about the file structure, give credit to micros for "taking up the cause" and tell what it was like developing on the early machines, as well as describe how the UNIX development group came about, with the organizational separation of the research group from the development effort. Here, it is interesting to note that Ritchie and Thompson gave up active support of the development effort even before the release of Version 7 (the 7th Edition) of UNIX—they were working in the research area and were not interested in the problems and effort involved in developing UNIX as a releasable product.

Peter Brooks describes how you can get UNIX multitasking on the PC with IBM's PC/IX from Interactive Software. We learn that this standard UNIX System III implementation runs better than you'd think—and better than it's been reported elsewhere—on the PC. Besides presenting an excellent review of PC/IX, he provides a chart of the hierarchical file directory structure for the system as it is delivered—and describes how to configure PC/IX for multiuser operation.

John Malpas and Kathy O'Leary review a very affordable implementation of UNIX System V on a Convergent Technologies Miniframe, and Ronald Gombach presents the first in an ongoing series of personal views of UNIX. In the latter, Gombach opens the series by talking about how different groups view UNIX relative to how they use it—the unity of an operating system born of the eclecticism of its users. In addition to this series, we are planning a long-distance mail interview with several notable individuals from the world of UNIX, with the cooperation of the folks from Unisoft. Finally, Dr. C. R. (Chris) Howlett presents a review of the C Power Packs, a powerful set of subroutine libraries that can greatly increase the efficiency of programming in C.

So, join with us as we travel through the early evolution of UNIX and branch out to look at other areas of—The Worlds of UNIX.

Mark Rollins

The Evolution of the UNIX Timesharing System

by Dennis M. Ritchie

ABSTRACT

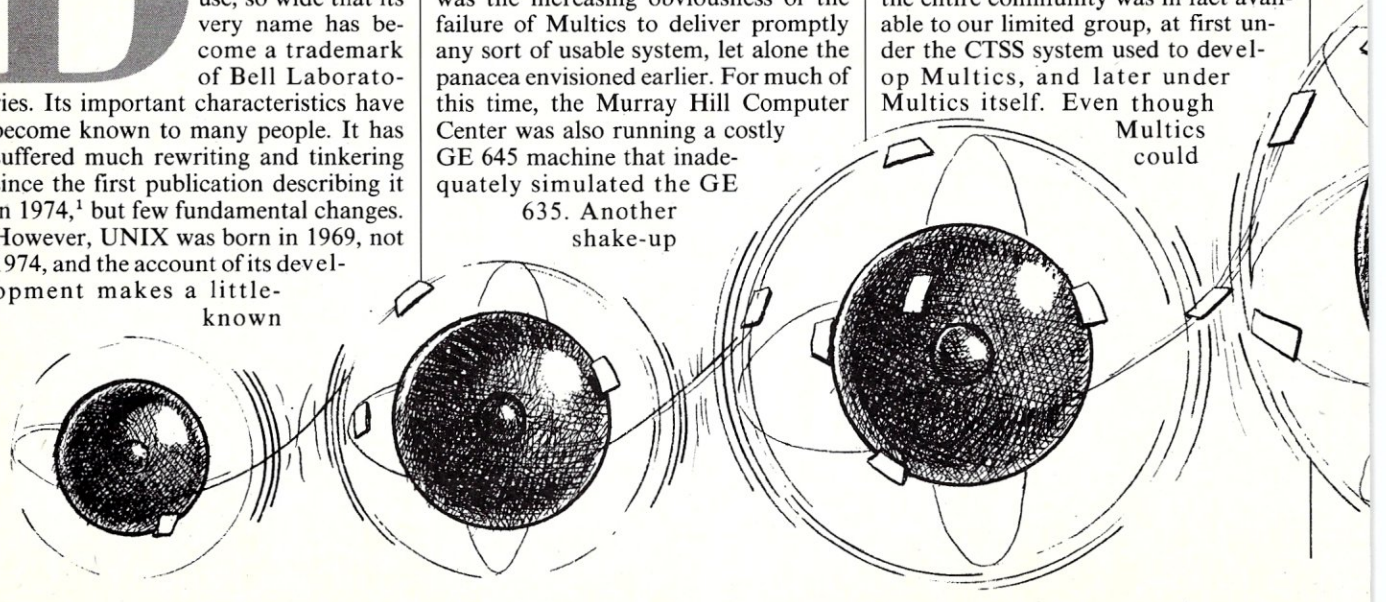
This paper presents a brief history of the early development of the Unix operating system. It concentrates on the evolution of the file system, the process-control mechanism, and the idea of pipelined commands. Some attention is paid to social conditions during the development of the system.

During the past few years, the UNIX operating system has come into wide use, so wide that its very name has become a trademark of Bell Laboratories. Its important characteristics have become known to many people. It has suffered much rewriting and tinkering since the first publication describing it in 1974,[1] but few fundamental changes. However, UNIX was born in 1969, not 1974, and the account of its development makes a little-known and perhaps instructive story. This paper presents a technical and social history of the evolution of the system.

Origins

For computer science at Bell Laboratories, the period 1968-1969 was somewhat unsettled. The main reason for this was the slow, though clearly inevitable, withdrawal of the Labs from the Multics project. To the labs computing community as a whole, the problem was the increasing obviousness of the failure of Multics to deliver promptly any sort of usable system, let alone the panacea envisioned earlier. For much of this time, the Murray Hill Computer Center was also running a costly GE 645 machine that inadequately simulated the GE 635. Another shake-up that occured during this period was the organizational separation of computing services and computing research.

From the point of view of the group that was to be most involved in the beginnings of UNIX (K. Thompson, Ritchie, M. D. McIlroy, J. F. Ossanna), the decline and fall of Multics had a directly felt effect. We were among the last Bell Laboratories holdouts actually working on Multics, so we still felt some sort of stake in its success. More important, the convenient interactive computing service that Multics had promised to the entire community was in fact available to our limited group, at first under the CTSS system used to develop Multics, and later under Multics itself. Even though Multics could



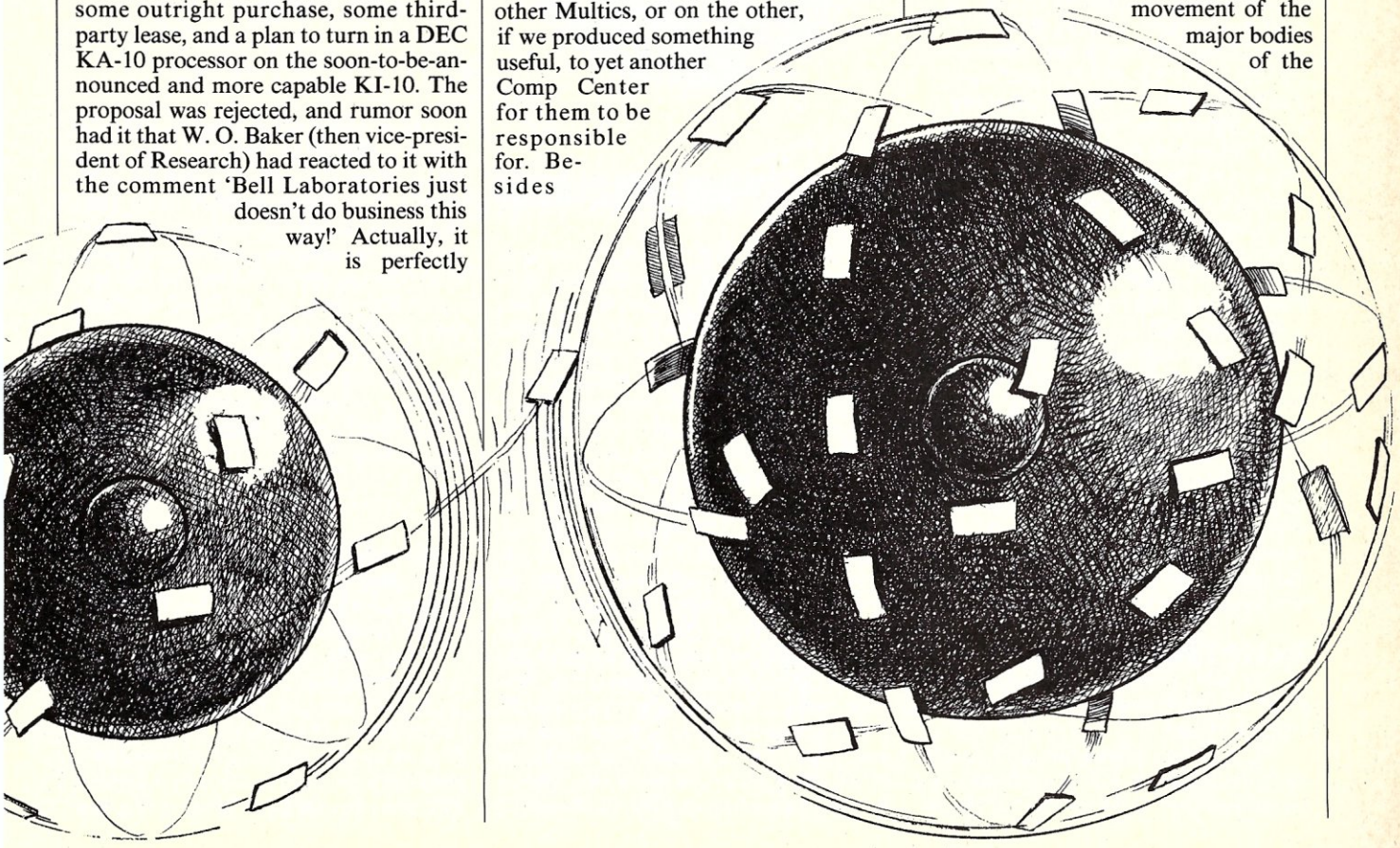
not then support many users, it could support us, albeit at exorbitant cost. We didn't want to lose the pleasant niche we occupied, because no similar ones were available; even the time-sharing service that would later be offered under GE's operating system did not exist. What we wanted to preserve was not just a good environment in which to do programming, but a system around which a fellowship could form. We knew from experience that the essence of communal computing, as supplied by remote-access, time-shared machines, is not just to type programs into a terminal instead of a keypunch, but to encourage close communication.

Thus, during 1969, we began trying to find an alternative to Multics. The search took several forms. Throughout 1969 we (mainly Ossanna, Thompson, Ritchie) lobbied intensively for the purchase of a medium-scale machine for which we promised to write an operating system; the machines we suggested were the DEC PDP-10 and the SDS (later Xerox) Sigma 7. The effort was frustrating, because our proposals were never clearly and finally turned down, but yet were certainly never accepted. Several times it seemed we were very near success. The final blow to this effort came when we presented an exquisitely complicated proposal, designed to minimize financial outlay, that involved some outright purchase, some third-party lease, and a plan to turn in a DEC KA-10 processor on the soon-to-be-announced and more capable KI-10. The proposal was rejected, and rumor soon had it that W. O. Baker (then vice-president of Research) had reacted to it with the comment 'Bell Laboratories just doesn't do business this way!' Actually, it is perfectly

For computer science at Bell Labs, the period 1968-69 was somewhat unsettled.

obvious in retrospect (and should have been at the time) that we were asking the Labs to spend too much money on too few people with too vague a plan. Moreover, I am quite sure that at that time operating systems were not, for management, an attractive area in which to support work. They were in the process of extricating themselves not only from an operating system development effort that had failed, but from running the local Computation Center. Thus it may have seemed that buying a machine such as we suggested might lead on the one hand to yet another Multics, or on the other, if we produced something useful, to yet another Comp Center for them to be responsible for. Besides the financial agitations that took place in 1969, there was technical work also. Thompson, R. H. Canaday, and Ritchie developed, on blackboards and scribbled notes, the basic design of a file system that was later to become the heart of UNIX. Most of the design was Thompson's, as was the impulse to think about file systems at all, but I believe I contributed the idea of device files. Thompson's itch for creation of an operating system took several forms during this period; he also wrote (on Multics) a fairly detailed simulation of the performance of the proposed file system design and of paging behavior of programs. In addition, he started work on a new operating system for the GE-645, going as far as writing an assembler for the machine and a rudimentary operating system kernel whose greatest achievement, so far as I remember, was to type a greeting message. The complexity of the machine was such that a mere message was already a fairly notable accomplishment, but when it became clear that the lifetime of the 645 at the Labs was measured in months, the work was dropped.

Also during 1969, Thompson developed the game of 'Space Travel.' First written on Multics, then transliterated into Fortran for GECOS (the operating system for the GE, later Honeywell, 635), it was nothing less than a simulation of the movement of the major bodies of the



Evolution

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Solar System, with the player guiding a ship here and there, observing the scenery, and attempting to land on the various planets and moons. The GECOS version was unsatisfactory in two important respects: first, the display of the state of the game was jerky and hard to control because one had to type commands at it, and second, a game cost about $75 for CPU time on the big computer. It did not take long, therefore, for Thompson to find a little-used processor; the whole system was used as a Graphic-II terminal. He and I rewrote Space Travel to run on this machine. The undertaking was more ambitious than it might seem; because we disdained all existing software, we had to write a floating-point arithmetic package, the pointwise specification of the graphic characters for the display, and a debugging subsystem that continuously displayed the contents of typed-in locations in a corner of the screen. All this was written in assembly language for a cross-assembler that ran under GECOS and produced paper tapes to be carried to the PDP-7.

Space Travel, though it made a very attractive game, served mainly as an introduction to the clumsy technology of preparing programs for the PDP-7. Soon Thompson began implementing the paper file system (perhaps 'chalk file system' would be more accurate) that had been designed earlier. A file system without a way to exercise it is a sterile proposition, so he proceeded to flesh it out with the other requirements for a working operating system, in particular the notion of processes. Then came a small set of user-level utilities: the means to copy, print, delete, and edit files, and of course a simple command interpreter (shell). Up to this time all the programs were written using GECOS and files were transferred to the PDP-7 on paper tape; but once an assembler was completed the system was able to support itself. Although it was not until well into 1970 that Brian Kernighan suggested the name 'UNIX,' in a somewhat treacherous pun on 'Multics,' the operating system we know today was born.

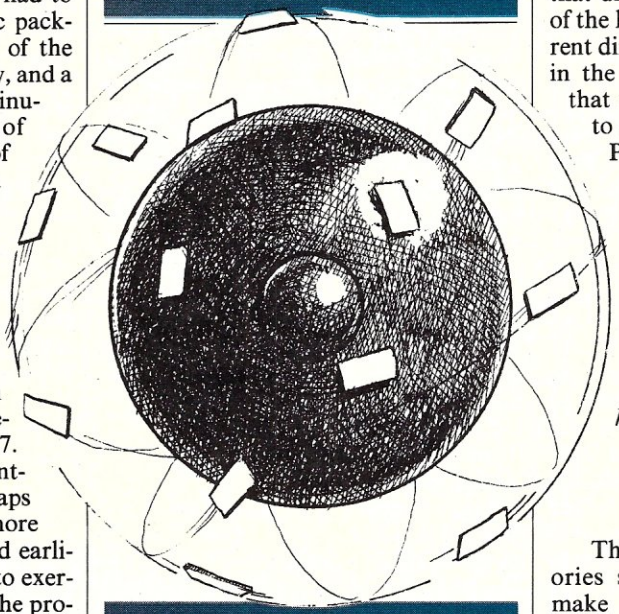
The PDP-7 UNIX file system

Structurally, the file system of PDP-7 UNIX was nearly identical to today's. It had

1. An i-list: a linear array of *i-nodes* each describing a file. An i-node contained less than it does now, but the essential information was the same: the protection mode of the file, its type and size, and the list of physical blocks holding the contents.

2. Directories: a special kind of file containing a sequence of names and the associated i-number.

The search for an alternative to Multics took several forms.



3. Special files describing devices. The device specification was not contained explicitly in the i-node, but was instead encoded in the number: specific i-numbers corresponded to specific files.

The important file system calls were also present from the start. Read, write, open, creat (sic), close: with one very important exception, discussed below, they were similar to what one finds now. A minor difference was that the unit of I/O was the word, not the byte, because the PDP-7 was a word-addressed machine. In practice this meant merely that all programs dealing with character streams ignored null characters, because null was used to pad a file to an even number of characters. Another minor, occasionally annoying difference was the lack of erase and kill processing for terminals. Terminals, in effect, were always in raw mode. Only a few programs (notably the shell and the editor) bothered to implement erase-kill processing.

In spite of its considerable similarity to the current file system, the PDP-7 file system was in one way remarkably different: there were no path names, and each filename argument to the system was a simple name (without '/') taken relative to the current directory. Links, in the usual UNIX sense, did exist. Together with an elaborate set of conventions, they were the principal means by which the lack of path names became acceptable.

The *link* call took the form

```
link(dir, file, newname)
```

where *dir* was a directory file in the current directory, *file* an existing entry in that directory, and *newname* the name of the link, which was added to the current directory. Because *dir* needed to be in the current directory, it is evident that today's prohibition against links to directories was not enforced; the PDP-7 UNIX file system had the shape of a general directed graph.

So that every user did not need to maintain a link to all directories of interest, there existed a directory called *dd* that contained entries for the directory of each user. Thus, to make a link to file *x* in directory *ken*, I might do

```
ln dd ken ken
ln ken x x
rm ken
```

This scheme rendered subdirectories sufficiently hard to use as to make them unused in practice. Another important barrier was that there was no way to create a directory while the system was running; all were made during recreation of the file system from paper tape, so that directories were in effect a nonrenewable resource.

The *dd* convention made the *chdir* command relatively convenient. It took multiple arguments, and switched the current directory to each named directory in turn. Thus

```
chdir dd ken
```

would move to directory *ken*. (Incidentally, *chdir* was spelled *ch*; why this was expanded when we went to the PDP-11 I don't remember.)

The most serious inconvenience of the implementation of the file system, aside from the lack of path names, was the difficulty of changing its configuration; as mentioned, directories and special files were both made only when the disk was recreated. Installation of a new

device was very painful, because the code for devices was spread widely throughout the system; for example there were several loops that visited each device in turn. Not surprisingly, there was no notion of mounting a removable disk pack, because the machine had only a single fixed-head disk.

The operating system code that implemented this file system was a drastically simplified version of the present scheme. One important simplification followed from the fact that the system was not multiprogrammed; only one program was in memory at a time, and control was passed between processes only when an explicit swap took place. So, for example, there was an *iget* routine that made a named i-node available, but it left the i-node in a constant, static location rather than returning a pointer into a large table of active i-nodes. A precursor of the current buffering mechanism was present (with about four buffers) but there was essentially no overlap of disk I/O with computation. This was avoided not merely for simplicity. The disk attached to the PDP-7 was fast for its time; it transferred one 18-bit word every 2 microseconds. On the other hand, the PDP-7 itself had a memory cycle time of 1 microsecond, and most instructions took two cycles (one for the instruction itself, one for this operand). However, indirectly addressed instructions required three cycles, and indirection was quite common, because the machine had no index registers. Finally, the DMA controller was unable to access memory during an instruction. The upshot was that the disk would incur overrun errors if any indirectly addressed instructions were executed while it was transferring. Thus control could not be returned to the user, nor in fact could general system code be executed, with the disk running. The interrupt routines for the clock and terminals, which needed to be runnable at all times, had to be coded in very strange fashion to avoid indirection.

Process control

By 'process control,' I mean the mechanisms by which processes are created and used; today the system calls *fork*, *exec, wait,* and *exit* implement these mechanisms. Unlike the file system, which existed in nearly its present form from the earliest days, the process control scheme underwent considerable mutation after PDP-7 UNIX was already in use. (The introduction of path names in the PDP-11 systems was certainly a considerable notational advance, but not a change in fundamental structure.)

Today, the way in which commands are executed by the shell can be summarized as follows:

1. The shell reads a command line from the terminal.
2. It creates a child process by *fork.*
3. The child process uses *exec* to call in the command from a file.

We developed, on blackboards and scribbled notes, the basic design of a file system that became the heart of UNIX.

4. Meanwhile, the parent shell uses *wait* to wait for the child (command) process to terminate by calling *exit.*
5. The parent shell goes back to step 1.

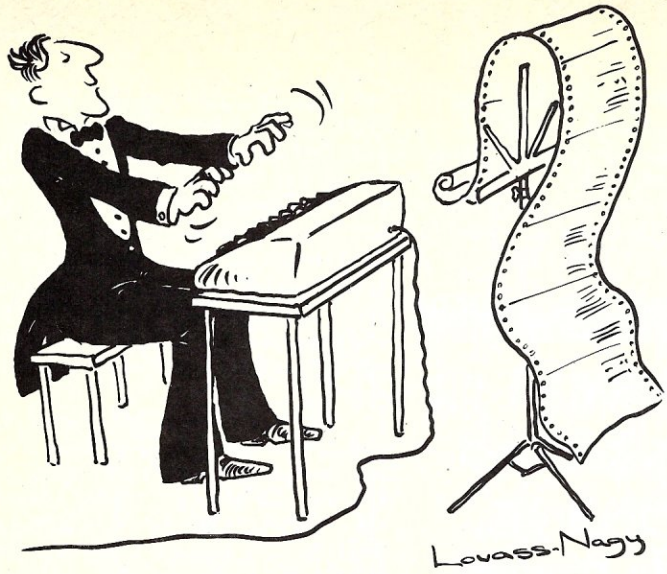
Processes (independently executing entities) existed very early in PDP-7 UNIX. There were in fact precisely two of them, one for each of the two terminals attached to the machine. There was no *fork, wait,* or *exec*. There was an *exit,* but its meaning was rather different, as will be seen. The main loop of the shell went as follows:

1. The shell closed all its open files, then opened the terminal special file for standard input and output (file descriptors 0 and 1).
2. It read a command line from the terminal.
3. It linked to the file specifying the command, opened the file, and removed the link. Then it copied a small bootstrap program to the top of memory and jumped to it; this bootstrap program read in the file over the shell code, then jumped to the first location of the command (in effect an *exec*).
4. The command did its work, then terminated by calling *exit*. The *exit* call caused the system to read in a fresh copy of the shell over the terminated command, then to jump to its start (and thus in effect to go to step 1).

The most interesting thing about this primitive implementation is the degree to which it anticipated themes developed more fully later. True, it could support neither background processes nor shell command files (let alone pipes and filters); but I/O redirection (via '<' and '>') was soon there; it is discussed below. The implementation of redirection was quite straightforward; in step 3 above, the shell just replaced its standard input or output with the appropriate file. Crucial to subsequent development was the implementation of the shell as a user-level program stored in a file, rather than a part of the operating system.

The structure of this process control scheme, with one process per terminal, is similar to that of many interactive systems, for example CTSS, Multics, Honeywell TSS, and IBM TSS and TSO. In general such systems require special mechanisms to implement useful facilities such as detached computations and command files; UNIX at that stage didn't bother to supply the special mechanisms. It also exhibited some irritating, idiosyncratic problems. For example, a newly recreated shell had to close all its open files both to get rid of any open files left by the command just executed and to rescind previous I/O redirection. Then it has to reopen the special file corresponding to its terminal in order to read a new command line. There was no */dev* directory (because no path names); moreover, the shell could retain no memory across commands, because it was re-executed afresh after each command. Thus a further file system convention was required: each direction had to contain an entry *tty* for a special file that referred to the terminal of the process that opened it. If by accident one changed into some directory that lacked this entry, the shell would loop hopelessly; about the only remedy was to reboot. (Sometimes the missing link could be made from the other terminal.)

Process control in its modern form was designed and implemented within a couple of days. It is astonishing how easily it fitted into the existing system; at the same time it is easy to see how some of the slightly unusual features of the design are present precisely because they represented small, easily coded changes to what existed. A good example is the separation of the *fork* and *exec* functions. The most common model for the creation of new processes involves specifying a program for the process to execute; in UNIX, a forked process continues to run the same program as its parent until it performs an explicit *exec.* The separation of the functions is certainly not unique to UNIX, and in fact it was present in the Berkeley time-sharing system,[2] which was well-known to Thompson. Still, it seems reasonable to suppose that it exists in UNIX mainly because of the ease with which *fork*



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Evolution

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could be implemented without changing much else. The system already handled multiple (i.e. two) processes; there was a process table, and the processes were swapped between main memory and the disk. The initial implementation of *fork* required only

1. Expansion of the process table
2. Addition of a fork call that copied the current process to the disk swap area, using the already existing swap I/O primitives; and made some adjustments to the process table.

In fact, the PDP-7's *fork* call required precisely 27 lines of assembly code. Of course, other changes in the operating system and user programs were required, and some of them were rather interesting and unexpected. But a combined *fork-exec* would have been considerably more complicated, if only because *exec* as such did not exist; its function was already performed, using explicit I/O, by the shell.

The *exit* system call, which previously read in a new copy of the shell (actually a sort of automatic *exec* but without arguments), simplified considerably; in the new version a process only had to clean out its process table entry, and give up control.

Curiously, the primitives that became *wait* were considerably more general than the present scheme. A pair of primitives sent one-word messages between named processes:

```
smes(pid, message)
(pid, message)=rmes()
```

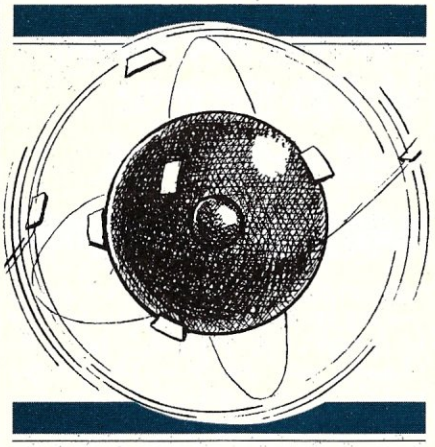
The target process of *smes* did not need to have any ancestral relationship with the receiver, although the system provided no explicit mechanism for communicating process IDs except that *fork* returned to each of the parent and child the ID of its relative. Messages were not queued; a sender delayed until the receiver read the message.

The message facility was used as follows: the parent shell, after creating a process to execute a command, sent a message to the new process by *smes*; when the command terminated (assuming it did not try to read any messages) the shell's blocked *smes* call returned an error indication that the target process did not exist. Thus the shell's *smes* became, in effect, the equivalent of *wait*.

A different protocol, which took advantage of more of the generality offered by message, was used between the initialization program and the shells for each terminal. The initialization process, whose ID was understood to be 1, created a shell for each of the terminals, and then issued *rmes*; each shell, when it read the end of its input file, used *smes* to send a conventional 'I am terminating' message to the initialization process, which recreated a new shell process for that terminal.

I can recall no other use of message.

Work began on the C language in 1971.



This explains why the facility was replaced by the *wait* call of the present system, which is less general, but more directly applicable to the desired purpose. Possibly relevant also is the evident bug in the mechanism: if a command process attempted to use messages to communicate with other processes, it would disrupt the shell's synchronization. The shell depended on sending a message that was never received; if a command executed *rms*, it would received the shell's phony message, and cause the shell to read another input line just as if the command had terminated. If a need for general messages had manifested itself, the bug would have been repaired.

At any rate, the new process control scheme instantly rendered some very valuable features trivial to implement; for example, detached processes (with '&') and recursive use of the shell as a command. Most systems have to supply some sort of special 'batch job submission' facility and a special command interpreter for files distinct from the one used interactively.

Although the multiple-process idea slipped in very easily indeed, there were some aftereffects that weren't anticipated. The most memorable of these became evident soon after the new system came up and apparently worked. In the midst of our jubilation, it was discovered that the *chdir* (change current directory) command had stopped working. There was much reading of code and anxious introspection about how the addition of *fork* could have broken the *chdir* call. Finally the truth dawned: in the old system *chdir* was an ordinary command; it adjusted the current directory of the (unique) process attached to the terminal. Under the new system, the *chdir* command correctly changed the current directory of the process created to execute it, but this process promptly terminated and had no effect whatsoever on its parent shell! It was necessary to make *chdir* a special command, executed internally within the shell. It turns out that several command-like functions have the same property, for example *login*.

Another mismatch between the system as it had been and the new process control scheme took longer to become evident. Originally, the read/write pointer associated with each open file was stored within the process that opened the file. (This pointer indicates where in the file the next read or write will take place.) The problem with this organization became evident only when we tried to use command files. Suppose a simple command file contains

```
ls
who
```

and it is executed as follows:

```
sh comfile>output
```

The sequence of events was

1. The main shell creates a new process, which opens *outfile* to receive the standard output and executes the shell recursively.
2. The new shell creates another process to execute *ls*, which correctly writes on file *output* and then terminates.
3. Another process is created to execute the next command. However, the I/O pointer for the output is copied from that of the shell, and it is still 0, because the shell has never written on its output, and I/O pointers are associated with processes. The effect is that the output of *who* overwrites and destroys the output of the preceding *ls* command.

Solution of this problem required creation of a new system table to contain the I/O pointers of open files independently of the process in which they were opened.

I/O redirection

The very convenient notation for I/O redirection, using the '>' and '<' characters, was not present from the very beginning of the PDP-7 UNIX sys-

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tem, but it did appear quite early. Like much else in UNIX, it was inspired by an idea from Multics. Multics has a rather general I/O redirection mechanism[3] embodying named I/O streams that can be dynamically redirected to various devices, files, and even through special stream-processing modules. Even in the version of Multics we were familiar with a decade ago, there existed a command that switched subsequent output normally destined for the terminal to a file, and another command to reattach output to the terminal. Where under UNIX one might say

```
ls>xx
```

to get a listing of the names of one's files in *xx*, on Multics the notation was

```
iocall attach user_output
       file xx list
iocall attach user_output
       syn user-i/o
```

Even though this very clumsy sequence was used often during the Multics days, and would have been utterly straightforward to integrate into the Multics shell, the idea did not occur to us or anyone else at the time. I speculate that the reason it did not was the sheer size of the Multics project: the implementors of the I/O system were at Bell Labs in Murray Hill, while the shell was done at MIT. We didn't consider making changes to the shell (it was *their* program); correspondingly, the keepers of the shell may not even have known of the usefulness, albeit clumsiness, of *iocall*. (The 1969 Multics manual[4] lists *iocall* as an 'author-maintained,' that is, non-standard, command.) Because both the UNIX I/O system and its shell were under the exclusive control of Thompson, when the right idea finally surfaced, it was a matter of an hour or so to implement it.

The advent of the PDP-11

By the beginning of 1970, PDP-7 UNIX was a going concern. Primitive by today's standards, it was still capable of providing a more congenial programming environment than its alternatives. Nevertheless, it was clear that the PDP-7, a machine we didn't even own, was already obsolete, and its successors in the same line offered little of interest. In early 1970 we proposed acquisition of a PDP-11, which had just been introduced by Digital. In some sense, this proposal was merely the latest in the series of attempts that had been made throughout the preceding year. It differed in two important ways. First, the amount of money (about $65,000) was an order of magnitude less than what we had previously asked; second, the charter sought was not merely to write some (unspecified) operating system, but instead to create a system specifically designed for editing and formatting text, what might today be called a 'word-processing system.' The impetus for the proposal came mainly from J. F. Ossanna, who was then and until the end of his life interested in text processing. If our early proposals were too vague, this one was perhaps too specific; at first it too met with disfavor. Before long, however, funds were obtained through the efforts of L. E. McMahon, and an order for a PDP-11 was placed in May.

Pipes appeared in UNIX in 1972, well after the PDP-11 version of the system was operating.

The processor arrived at the end of the summer, but the PDP-11 was so new a product that no disk was available until December. In the meantime, a rudimentary, core-only version of UNIX was written using a cross-assembler on the PDP-7. Most of the time, the machine sat in a corner, enumerating all the closed Knight's tours on a 6x8 chess board—a three-month job.

The first PDP-11 system

Once the disk arrived, the system was quickly completed. In internal structure, the first version of UNIX for the PDP-11 represented a relatively minor advance over the PDP-7 system; writing it was largely a matter of transliteration. For example, there was no multiprogramming; only one user program was present in core at any moment. On the other hand, there were important changes in the interface to the user: the present directory structure, with full path names, was in place, along with the modern form of *exec* and *wait,* and conveniences like character-erase and line-kill processing for terminals. Perhaps the most interesting thing about the enterprise was its small size: there were 24K of core memory (16K for the system, 8K for user programs), and a disk with 1K blocks (512K). Files were limited to 63K.

At the time of the placement of the order for the PDP-11, it had seemed natural, or perhaps expedient, to promise a system dedicated to word processing. During the protracted arrival of the hardware, the increasing usefulness of PDP-7 UNIX made it appropriate to justify creating PDP-11 UNIX as a development tool, to be used in writing the more special-purpose system. By the spring of 1971, it was generally agreed that no one had the slightest interest in scrapping UNIX. Therefore, we transliterated the *roff* text formatter into PDP-11 assembler language, starting from the PDP-7 version that had been transliterated from McIlroy's BCPL version on Multics, which had in turn been inspired by J. Saltzer's *runoff* program on CTSS. In early summer, editor and formatter in hand, we felt prepared to fulfill our charter by offering to supply a text-processing service to the Patent department for preparing patent applications. At the time, they were evaluating a commercial system for this purpose; the main advantages we offered (besides the dubious one of taking part in an in-house experiment) were two in number: first, we supported Teletype's model 37 terminals, which, with an extended type-box, could print most of the math symbols they required; second, we quickly endowed *roff* with the ability to produce line-numbered pages, which the Patent Officer required and which the other system could not handle.

During the last half of 1971, we supported three typists from the Patent department, who spent the day busily typing, editing, and formatting patent applications, and meanwhile tried to carry on our own work. UNIX has a reputation for supplying interesting services on modest hardware, and this period may mark a high point in the benefit/equipment ratio; on a machine with no memory protection and a single 0.5 MB disk, every test of a new program required care and boldness, because it could easily crash the system, and every few hours' work by the typists meant pushing out more information onto DECtape, because of the very small disk.

The experiment was trying but successful. Not only did the Patent department adopt UNIX, and thus become the first of many groups at the Laboratories to ratify our work, but we achieved sufficient credibility to convince our own management to acquire one of the first PDP-11/45 systems made. We have

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accumlated much hardware since then, and labored continuously on the software, but because most of the interesting work has already been published, (e.g. on the system itself[1,5,6] and the text processing applications[7,8,9]) it seems unnecessary to repeat it here.

Pipes

One of the most widely admired contributions of UNIX to the culture of operating systems and command languages is the *pipe*, as used in a pipeline of commands. Of course, the fundamental idea was by no means new; the pipeline is merely a specific form of coroutine. Even the implementation was not unprecedented, although we didn't know it at the time; the 'communication files' of the Dartmouth Time-Sharing System[10] did very nearly what UNIX pipes do, though they seem not to have been exploited so fully.

Pipes appeared in UNIX in 1972, well after the PDP-11 version of the system was in operation, at the suggestion (or perhaps insistence) of M. D. McIlroy, a long-time advocate of the non-hierarchical control flow that characterizes coroutines. Some years before pipes were implemented, he suggested that commands should be thought of as binary operators, whose left and right operand specified the input and output files. Thus a 'copy' utility would be commanded by

```
inputfile copy outputfile
```

To make a pipeline, command operators could be stacked up. Thus, to sort *input,* paginate it neatly, and print the result offline, one would write

```
input sort paginate offprint
```

In today's system, this would correspond to

```
sort input|pr|opr
```

The idea, explained one afternoon on a blackboard, intrigued us but failed to ignite any immediate action. There were several objections to the idea as put: the infix notation seemed too radical (we were too accustomed to typing 'cp x y' to copy *x* to *y*); and we were unable to see how to distinguish command parameters from the input or output files. Also, the one-input one-output model of command execution seemed too confining. What a failure of imagination!

Some time later, thanks to McIlroy's persistence, pipes were finally installed in the operating system (a relatively simple job), and a new notation was introduced. It used the same characters as for I/O redirection. For example, the pipeline above might have been written

```
sort input>pr>opr>
```

The idea is that following a '>' may be either a file, to specify redirection of output to that file, or a command into which the output of the preceding command is directed as input. The trailing

The watershed occurred in 1973, when the OS kernel was rewritten in C.

'>' was needed in the example to specify that the (nonexistent) output of *opr* should be directed to the console; otherwise the command *opr* would not have been executed at all; instead a file *opr* would have been created.

The new facility was enthusiastically received, and the term 'filter' was soon coined. Many commands were changed to make them usable in pipelines. For example, no one had imagined that anyone would want the *sort* or *pr* utility to sort or print its standard input if given no explicit arguments.

Soon some problems with the notation became evident. Most annoying was a silly lexical problem: the string after '>' was delimited by blanks, so, to give a parameter to *pr* in the example, one had to quote:

```
sort input>"pr -2">opr>
```

Second, in attempt to give generality, the pipe notation accepted '<' as an input redirection in a way corresponding to '>'; this meant that the notation was not unique. One could also write, for example,

```
opr<pr<"sort input"<
```

or even

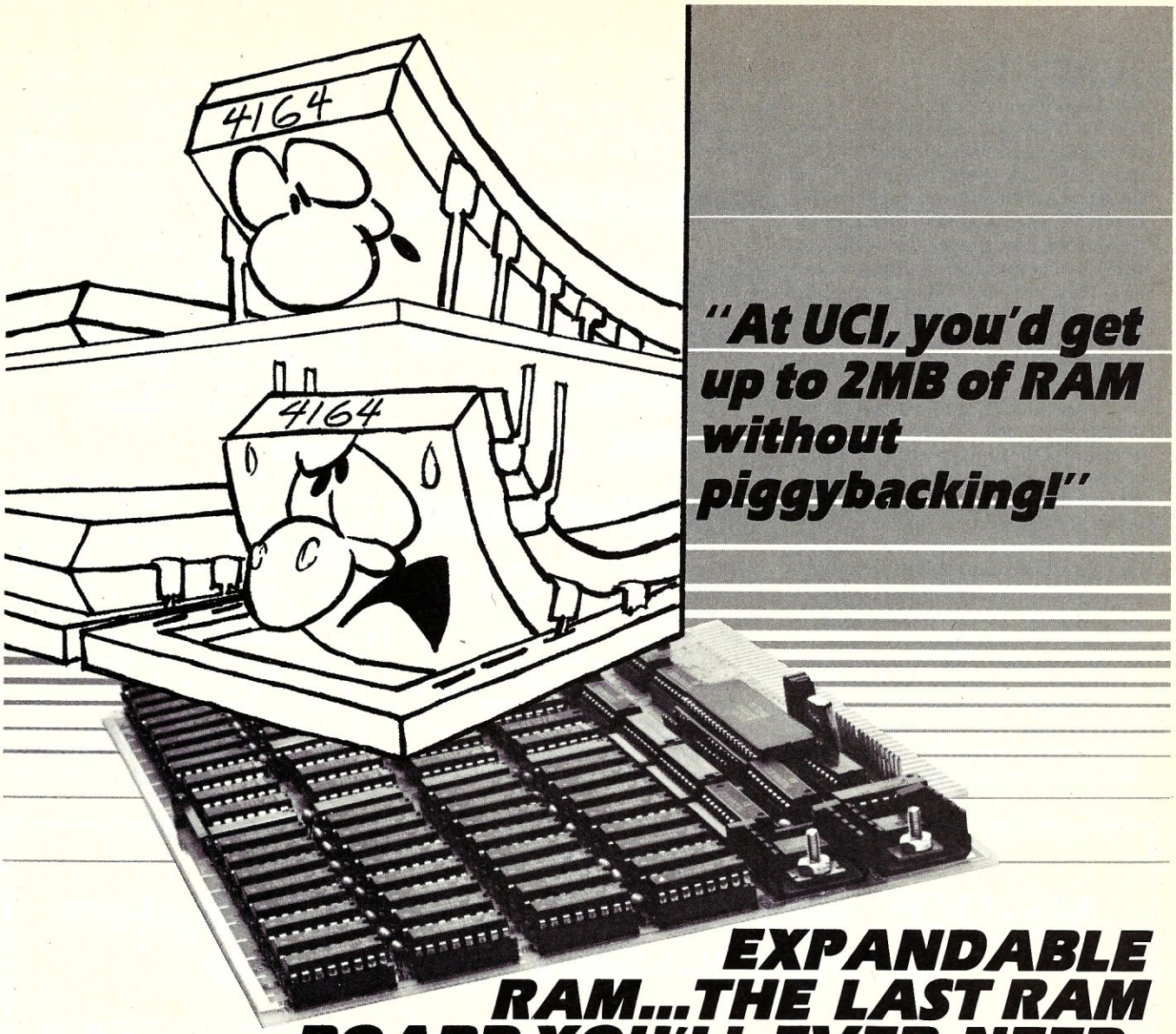
```
pr<sort input"<>opr>
```

The pipe notation using '<' and '>' survived only a couple of months; it was replaced by the present one that uses a unique operator to separate components of a pipeline. Although the old notation had a certain charm and inner consistency, the new one is certainly superior. Of course, it too has limitations. It is unabashedly linear, though there are situations in which multiple redirected inputs and outputs are called for. For example, what is the best way to compare the outputs of two programs? What is the appropriate notation for invoking a program with two parallel output streams?

I mentioned above in the section on I/O redirection that Multics provided a mechanism by which I/O streams could be directed through processing modules on the way to (or from) the device or file serving as source or sink. Thus it might seem that stream-splicing in Multics was the direct precursor of UNIX pipes, as Multics I/O redirection certainly was for its UNIX version. In fact I do not think this is true, or is true only in a weak sense. Not only were coroutines well-known already, but their embodiment as Multics spliceable I/O modules required that the modules be specially coded in such a way that they could be used for no other purpose. The genius of the UNIX pipeline is precisely that it is constructed from the very same commands used constantly in simplex fashion. The mental leap needed to see this possibility and to invent the notation is large indeed.

High-level languages

Every program for the original PDP-7 UNIX system was written in assembly language, and bare assembly language it was—for example, there were no macros. Moreover, there was no loader or link-editor, so every program had to be complete in itself. The first interesting language to appear was a version of McClure's TMG[11] that was implemented by McIlroy. Soon after TMG became available, Thompson decided that we could not pretend to offer a real computing service without Fortran, so he sat down to write a Fortran in TMG. As I recall, the intent to handle Fortran lasted about a week. What he produced instead was a definition of and a compiler for the new language B.[12] B was much influenced by the BCPL language;[13] other influences were Thompson's taste for spartan syntax, and the very small space into which the compiler had to fit. The compiler produced simple interpretive code; although it and the programs it produced were rather slow, it made life much more pleasant. Once interfaces to the regular system calls were made available, we began once again to enjoy the



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benefits of using a reasonable language to write what are usually called 'systems programs': compilers, assemblers, and the like. (Although some might consider the PL/I we used under Multics unreasonable, it was much better than assembly language.) Among other programs, the PDP-7 B cross-compiler for the PDP-11 was written in B, and in the course of time, the B compiler for the PDP-7 itself was transliterated from TMG into B.

When the PDP-11 arrived, B was moved to it almost immediately. In fact, a version of the multiprecision 'desk calculator' program *dc* was one of the earliest programs to run on the PDP-11, well before the disk arrived. However, B did not take over instantly. Only passing thought was given to rewriting the operating system in B rather than assembler, and the same was true of most of the utilities. Even the assembler was rewritten in assembler. This approach was taken mainly because of the slowness of the interpretive code. Of smaller but still real importance was the mismatch of the word-oriented B language with the byte-addressed PDP-11.

Thus, in 1971, work began on what was to become the C language.[14] The story of the language developments from BCPL through B to C is told elsewhere,[15] and need not be repeated here.

Process control was designed and implemented in a couple of days.

Perhaps the most important watershed occurred during 1973, when the operating system kernel was rewritten in C. It was at this point that the system assumed its modern form; the most far-reaching change was the introduction of multiprogramming. There were few externally visible changes, but the internal structure of the system became much more rational and general. The success of this effort convinced us that C was useful as a nearly universal tool for systems programming, instead of just a toy for simple applications.

Today, the only important UNIX program still written in assembler is the assembler itself; virtually all the utility programs are in C, and so are most of the applications programs, although there are sites with many in Fortran, Pascal, and Algol 68 as well. It seems certain that much of the success of UNIX follows from the readability, modifiability, and portability of its software that in turn follows from its expression in high-level languages.

Conclusion

One of the comforting things about old memories is their tendency to take on a rosy glow. The programming environment provided by the early versions of UNIX seems, when described here, to be extremely harsh and primitive. I am sure that if forced back to the PDP-7 I would find it intolerably limiting and lacking in conveniences. Nevertheless, it did not seem so at the time; the memory fixes on what was good and what lasted, and on the joy of helping to create the improvements that made life better. In 10 years, I hope we can look back

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with the same mixed impression of progress combined with continuity.

Acknowledgements

I am grateful to S. P. Morgan, K. Thompson, and M. D. McIlroy for providing early documents and digging up recollections.

Because I am most interested in describing the evolution of ideas, this paper attributes ideas and work to individuals only were it seems most important. The reader will not, on the average, go far wrong if he reads each occurrence of 'we' with unclear antecedent as 'Thompson, with some assistance from me.'

References

1. D. M. Ritchie and K. Thompson, "The UNIX Time-Sharing System," *Comm. Assoc. Comp. Mach.* 17(7), pp. 365-375 (July 1974).

2. L. P. Deutsch and B. W. Lampson, "SDS 930 time-sharing system preliminary reference manual," Doc. 30.10.10, Project GENIE, Univ. Cal. at Berkeley (April 1965).

3. R. J. Feiertag and E. I. Organick, "The Multics input-output system," *Proc. Third Symposium on Operating Systems Principles,* pp. 35-41 (October 18-20, 1971).

4. *The Multiplexed Information and Computing Service: Programmers' Manual,* Massachusetts Institute of Technology Project MAC, Cambridge, Massachusetts (1969).

5. K. Thompson, "UNIX Time-Sharing System: UNIX Implementation," *Bell Sys. Tech. J.* 57(6), pp. 1931-1946 (1978).

6. S. C. Johnson and D. M. Ritchie, "UNIX Time-Sharing System: Portability of C Programs and the UNIX System," *Bell Sys. Tech. J.* 57(6), pp. 2021-2048 (1978).

7. B. W. Kernighan, M. E. Lesk, and J. F. Ossanna, "UNIX Time-Sharing System: Document Preparation," *Bell Sys. Tech. J.* 57(6), pp. 2115-2135 (1978).

8. B. W. Kernighan and L. L. Cherry, "A System for Typesetting Mathematics," *Comm. Assoc. Comp. Mach.* 18, pp. 151-157 (March 1975).

9. M. E. Lesk and B. W. Kernighan, "Computer Typesetting of Technical Journals on UNIX," *Proc. AFIPS NCC* 46, pp. 879-888 (1977).

10. *Systems Programmers Manual for the Dartmouth Time Sharing System for the GE 635 Computer,* Dartmouth College, Hanover, New Hampshire (1971).

11. R. M. McClure, "TMG—a Syntax Directed Compiler," *Proc. 20th ACM National Conf.,* pp. 262-274 (1965).

12. S. C. Johnson and B. W. Kernighan, "The Programming Language B," *Comp. Sci. Tech. Rep. No. 8,* Bell Laboratories, Murray Hill, New Jersey (January 1973).

13. M. Richards, "BCPL: A Tool for Compiler Writing and Systems Programming," *Proc. AFIPS SJCC* 34, pp. 557-566 (1969).

14. B. W. Kernighan and D. M. Ritchie, *The C Programming Language,* Prentice-Hall, Englewood Cliffs, New Jersey (1978).

15. D. M. Ritchie, S. C. Johnson, M. E. Lesk, and B. W. Kernighan, "UNIX Time-Sharing System: The C Programming Language," *Bell Sys. Tech. J.* 57(6), pp. 1991-2019 (1978).

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Dennis M. Ritchie, Computing Science Research Center, AT&T Bell Laboratories, 600 Mountain Ave., Murray Hill, NJ 07974. Ritchie and Thompson were the chief developers of the UNIX system, and co-authored the original paper describing UNIX, which was published in 1974 in Comm. Assoc. Comp. Mach.

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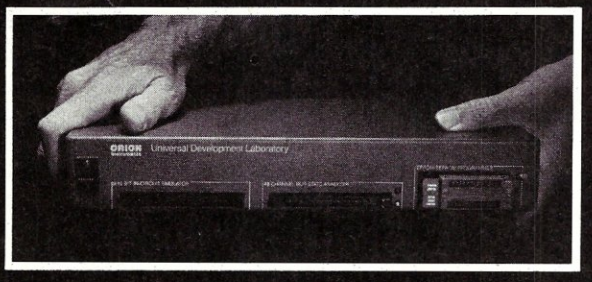

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A Conversation with Ritchie & Thompson

Microsystems talks with the founders of UNIX

Transcript of an interview between Microsystems (Mark, Chris) and Dennis Ritchie and Ken Thompson, at AT&T Murray Hill, NJ, on 1 August, 1984.

Mark: We'd like to find out, from *your* perspective, various things about UNIX that are different from what we've been hearing and reading. In particular, things of a general nature, like what you think the effect is going to be, in both directions, as UNIX gets out into the commercial world, and more specific internal things about UNIX, like the file and directory structures. For instance, I still don't quite understand the difference between Version 7, System III, and System V, in terms of what enhancements were put in for things like added file protections to keep the *inodes* from crashing. I worked on a development project using Version 7, and every two or three days the system would crash on us. We didn't just abort or shut the machine down without closing in an orderly fashion—the system just *went* down—and often took a lot of the inodes with it.

Dennis: Well, there are two things. One is that there can be bugs either in the hardware or possibly in the software that can just, you know, break things. The actual changes that have been made have to do with what state things are in when there is a crash and really it's not a change in the structure—the actual data on the disk is identical; it's just that the system is more careful about the order in which things are done.

Ken: The older systems had a buffer cache—just a pool of buffers—and I/O would be *logically* completed into the buffers by any requests from users or from the system maintaining its internal structure, like directories and things; the data would go into buffers, which were labeled blocks or just caches on the disk; then, the physical I/O would occur some random time later, whenever you got around to it...

Mark: Or whenever anything happened that would cause some kind of flush...

Ken: Yes, anything that would cause them to be overwritten, typically. Like, you'd use the buffers a lot, and when you reuse them, you'd write out the old contents before you'd relabel them. The later changes that I think you're talking about were intended to keep the system structures—like directories and inodes and things—consistent, by explicitly ordering the physical I/O, rather than leaving it up to traffic and chance.

Mark: How was that done?

Ken: When you create a file, or when

you delete a file, you just make sure that the directory is updated before the file, because you are remapping some old file, and when you clear out and free the blocks, you make sure that the file structure is written up before the blocks are freed.

Dennis: Like, when an indirect block is created, an inode points to a block that points to another block. So, you make sure that you don't write out the inode with a pointer to the indirect block before the indirect block is actually created, because if the system crashes right then, you've got a bad pointer; whereas, if you've already written out the indirect block, and forced it to be on disk, then you can update the inode. Then, even if the system crashes, you may have lost part of the file but you haven't created a bad structure. It's just being . . . it's really just sort of looking around, and . . .

Ken: . . . just being careful (laughter).

Dennis: Well, actually, even *thinking* about the possibility that things might simply stop at this point, and trying—as much as possible—to do things in an order so that, if the system just halted, the disk would be consistent.

Mark: In order to preserve the integrity of the data . . .

Dennis: Yes, and, even with the changes, it's not possible to do that totally—UNIX is not pretending to be a transaction system, committing transactions and backing out and all that. Just by exercising reasonable care, it can be made a lot more reliable. But, as far as crashes are concerned, and data being destroyed, it's also possible to have bugs somewhere—in the CPU hardware, the disk hardware, or the system itself.

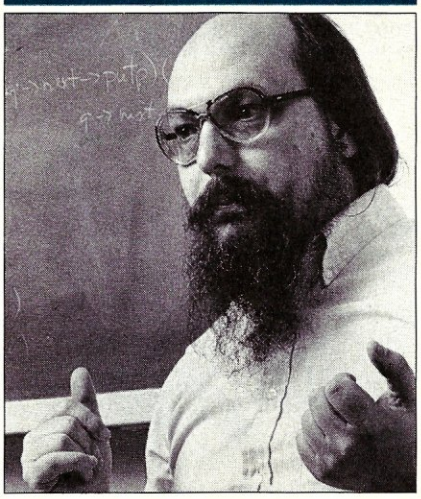
Traditionally, UNIX is very, very hard on machines, in the sense that it does things that other systems don't do . . .

Ken: . . . very asynchronously—lots of processes and lots of process switching. In the old days, DEC had *no* comparable system, and maybe 50% of the CPUs that you'd port UNIX on, that had been running some sort of DEC operating system or other, would just not run UNIX. I mean, there'd be big chunks of the CPU that had never worked in their whole life, like the memory management . . .

Mark: . . . because the CPU had never been properly debugged?

Ken: Yes. And in the old systems, the Unibus was very bad . . . the I/O, reflections, angles, and so on—electrically it was just an awful thing.

Mark: How do you feel about the ports to the new CPUs, like some of the micros? In fact I've wondered if you guys ever thought about whether we mavericks in the micro world would be able to get UNIX up and running on micros.



"... it was the micro that took up UNIX's cause."

Dennis: The interesting thing is that, for most of its life, UNIX *was* running on a micro, considerably smaller than the current ones, and it was the micro that took up the cause.

Ken: It had 8K words of 12 . . . no, 18-bit core.

Dennis: The PDP-11, the first one, had 24K bytes.

Ken: But, I don't know. UNIX doesn't *really* run well on traditional small 8-bit machines. It's only the 16-bit machines that can really run it.

Mark: We're not even really looking at 8-bit machines any more.

Chris: I didn't even realize anybody had even tried to port UNIX to an 8-bit machine.

Dennis: I don't think there have been any actual ports.

Ken: There have been some . . . IDRIS runs on it, doesn't it?.

Mark: Have you been involved with Whitesmiths at all with their development of IDRIS—do you help them, or have they called you, or anything?

Dennis: No. In fact, they were one of the very first independent developers of C compilers and stuff like that.

Of course, there's also Yourdon. And particularly because he was the first, and because he had been here [at Bell Labs], he was ultra, ultra careful with not getting into trouble with licensing problems. And I think it hurt him, because the library for his C compiler didn't use I/O calls compatible with the standard I/O. And, I think it's because he thought he would have gotten into trouble. I don't think he would have—because the published stuff has never been a trade secret, basically.

I think he's changed, actually, to where he's now using compatible stuff. There was actually *very* little communication with us. In fact, Brian [Kernighan] complained that they were doing all their software tools in Pascal, and wouldn't communicate enough. But that is a different story.

Mark: How much were you involved with the people here, at Bell Labs, who are working on things like C compilers and doing other UNIX system things?

Dennis: The people doing the UNIX-related development have all moved to a facility in Summit, which is a couple of miles away. They used to be here.

Mark: That's new development . . .

Ken: System V.

Dennis: Actually, yeah, the developers, the people who are doing new things.

Mark: What is your relationship with them?

Dennis: Organizationally, practically none at all. We're in the research area, they're in the computer line of business—the development area. As far as relations are concerned, there's a *lot* of exchange, with complaints about performance from us, and stuff going back and forth. In terms of details, we'll go over some area of a compiler and send it back, or write some new software and give it to them. To some extent, that's been going on since they started. More so, since the head of the department that's involved with compilers was also a head here, and decided he wanted to . . .

Ken: He wanted to link up . . .

Dennis: Yeah, link things, and actually get them done. As far as the operating system development is concerned, there is less trading back and forth, for most purposes. Part of the reason is that we have pretty much diverged in develop-

Conversation

Continued from page 51

ment. In effect, we in Research have our own successor to the 7th Edition, and have continued on that line. They have System V.

Mark: Would you have thought of it as another enhancement of System V, or as a different V, somehow?

Dennis: Our system will not be a product.

Mark: I see. You mean, they use the research from what you're doing.

Dennis: Right.

Ken: They're official, and we're research.

Dennis: So that, they take ideas. I mean, they've got the code, too—but the point is, it's not a whole system. As far as distributing a new system from *us* is concerned, there are two things that argue against it: first, we don't want to do it—it's an incredible amount of work; to get it all together. It's just not research. And second, it would be competing with System V. So, by mutual agreement, we don't do it. It's conceivable that there will be some *very* limited licenses to people we eventually would like to work with, but it's not certain who they might be, and, in fact, it would have to be on a private basis.

Mark: The activity of putting UNIX to work in the user world is quite different from what you're really interested in, isn't it?

Ken: Mm, hmm. Our job is research. It's not product oriented—there's no direction, and there's no management to speak of, no nothing. It's a sandbox; you know, anything we want to do.

Dennis: And now and again some good stuff comes out. UNIX is sort of unusual, because, well, in the first place, we *did* actually take the trouble to put together an actual distribution that could be fairly widely set out.

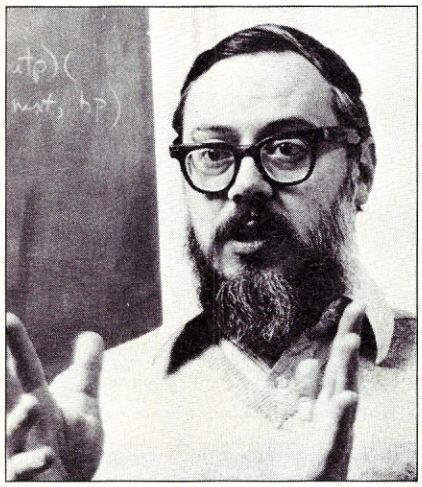
And it happened at a time when the company was not in a position to do it as a product, so that they charged license fees. There were individuals who wanted to make the fees as high as possible, just to see if we could make as much money as possible, but it was not really a business, in any sense of the word. And, of course, it wasn't supported, as a product either.

Chris: Would you say, then, that UNIX developed as a research tool, more than anything else?

Ken: Well, there was never really a direct object, so much, as trying to build something we could use ourselves.

Dennis: It was *definitely* not designed as a product.

Mark: But, Dennis, wasn't your comment on the phone last week that it was designed just as much for development



"Our job is research... it's a sandbox, you know, anything we want to do."

of a chess program? (laughter all around).

Ken: To be honest, it predated the chess work by a considerable amount. UNIX was designed for programming, and whatever else we wanted to do. At the time, I was more interested in languages than systems. The act of creating it changed that somewhat.

Mark: How do you feel about the current argument about UNIX—i.e., the two items: file/record locking and real-time operations? We've heard a lot of complaints from the "commercial" world that says, well, UNIX is not a real-time operating system. But, many people don't really seem to know what that means, or how it could be, because AT&T has got to be the premier real-time corporation, perhaps in the world.

Ken: But, UNIX does not switch phones (laughter).

Dennis: The reason that there's no real-time—I should say *closely* real-time—stuff in UNIX, is basically that we never came up with any application where we wanted to put it in. The things that got in there were the things that...

Ken: ...*we* needed. It was not developed as a product. From the first, there were groups of people who said they had to have shadow disks, and transaction processing, and other things. But those things just never interested us, so they never went in.

Mark: I see. Well, there's an interesting aspect to the arguing, because of the diversity of people involved. There's almost, like, a layered structure in the groups of people involved with UNIX right now: First, there's the research people—you guys—who conceived of and created UNIX; then there's a core of people—mostly college kids/recent graduates who learned UNIX just because that's what they had in school. They're the "hackers" and "gurus"—people who have an emotional investment in it because it's what they know; and then, there's another layer around that: the system people—people who have been working with other operating systems, and now they're learning UNIX. Finally, there's the commercial world—which is buying into UNIX because of the portability and other advantages that are there. Now, there's this great big argument raging between the commercial layer and the second layer, who are arguing: "But, record locking and real-time processing don't belong in there because they would destroy the integrity of the kernel and the philosophy of UNIX."

Dennis: Well, there are technical reasons...

Ken: I think System V *has* record locking. They have a driver of some sort, don't they?

Dennis: They have mechanisms for it. There are semaphores, with which, by agreement, you can have record locking; and Berkeley has file locking. Actually, there are two things, here. Real-time is moderately hard to implement in any general way, just because it's pretty much incompatible with the requirements of a time-sharing system.

Chris: I'm sorry, but isn't a time-sharing system inherently a real-time system? What do *you* mean, then, by a real-time system? This term is evidently confusing to a lot of people.

Dennis: What I mean by a real-time system is one in which the system undertakes to make some sort of guarantees about performance for particular tasks. Now, obviously, the system has to echo

characters as you type, and if it doesn't do it fairly fast, you get complaints. So, in that sense, it's real time. But it doesn't guarantee that some job will get 3/5 of the CPU. Nor does UNIX promise, if a task demands service, that it will get it in so many milliseconds. It's not impossible to design such a feature and put it in, but it really *is* basically incompatible with UNIX, particularly when you try to do it in a general way. Obviously, if you have a particular device that demands, or is delivering, data at some required speed, you can make a driver for it, and get it to work, somehow. But, to do it in a general way is much harder.

Mark: The issue of doing things in a general way brings up a problem. Let's say you want to write a program that outputs to a terminal which has cursor addressing, and you want to update some information fields while the program is running. The cursor control lets you format the screen, so that you can update just the fields without redisplaying the strings around the fields. Now, when you have your hands right on the I/O drivers, as in both CP/M and MS-DOS...

Dennis: That's the problem. I mean, the system was designed to make the two kinds of I/O be the same—that was the point. Having your hands on the I/O drivers is how you get into trouble, because then you're stuck with them.

Ken: And there's also all sorts of weird numbers and things that are built in.

Dennis: Block sizes, for instance.

Mark: What did you do about the degradation of system performance back when you were first working on it? Because, putting in generality costs you some system performance.

Ken: I think, by and large, things got better rather than worse. There's a right way, and a wrong way, and that's wrong. If you do it the generic way, and it's a problem—if it's not fast enough—then you figure out some way to *make* it fast enough, 'cause having your hands on the drivers is just wrong.

Dennis: Actually, things *are* getting better. I get the impression that people *are* beginning to try and generalize and pull back along those lines.

Mark: Beginning. But we still have three, four, even five kinds of opens, depending on the compiler, in order to accommodate different specific requirements; I mean, even in C compilers, things don't work right if you use only the general form that's been provided. You just can't always make it do what you want. You may find the compiler doing automatic conversions of cr/lf's to lf's, or vice versa, when what the application needs is to get every single bit coming in. Things like that.

Ken: Usually, those are symptoms of trying to be upward compatible with something else that you had in the past, and we just never felt that need. *We* designed it. We're not upward compatible with *anything*. We weren't constrained.

Mark: How about future development, going *from* what you did?

Ken: Well, now there's a *tremendous* inertia on the software behind UNIX. The system is actually the minor part of it. All of the subsystems—the languages, and so forth—represent probably 10 to 100 times as much effort and work and inertia, as the system itself.

Mark: How large *was* the system initially? I understand it takes about 256K of core and an average of 7 meg of disk primitives—that's the *general* size that UNIX is considered to be.

Ken: As it's described in the *CACM* article—that's the first public description of it—it was 10K...

Dennis: ...lines of code, and about 20K bytes of core. The first PDP-ll that we used for a couple of years had 24K bytes of core and a half-megabyte disk. On the other hand, the first PDP-11 that we got cost around $50,000, which was, for a computer, not very much at that time. I mean, this was 1969-70.

Chris: At that point, about the only thing you could get for less was a PDP-8, which was not comparable, so it *was* a small machine. But, then, what takes up the bulk?

Ken: When you're in, you tune the number of disks you need for the system buffer. There's a buffer pool, that, if it's larger, it's more efficient. You actually do less disk I/O; the I/O is accomplished inside the buffer's cache. There are some systems that have literally megabytes of buffer. The number of buffers is a parameter that you provide. You can have as many as you want; you can get away with two, but...

Dennis: I think the standard thing we're running allocates buffers on the basis of how much main memory you actually have. It's about 10 or 12 percent of the main memory.

Ken: And it allocates buffers on the basis of the number of users. That is, the number of I/O devices.

Dennis: But, there are two things. The text size—program size—of the system has been increasing noticeably. System V has added a whole bunch of features that various people wanted—and could use—but that really were not all that

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Conversation

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well thought out or coherent. You know, different features to do this and that and the other thing; they were added because they had customers who argued, and people who wanted them...

Mark: You mean, as it was becoming commercialized?

Dennis: No, it was not commercial, this was mostly internal.

Ken: System V grew out of System III; the additions were internal releases, inside the system, and maintained inside the system. That's the reason System IV is missing. There was a policy to have, basically, three systems in the works. There is *the* system that they're maintaining inside—let's call it System IV. There's one they're working on, experimentally, in the development group—that's V; and there's one they release to the outside world, which is one behind—III. So that, while we're using IV, we'll give out III...

Mark: ...and experiment with V...

Ken: Right. And then, when they decided to release UNIX as a product, they brought it up to date, so that the external and the internal are the same—and IV disappeared. IV was internal, as a product, and then when V came out, it was decided to skip IV as the external product and just have V.

Mark: One of the rumors that's spreading around is that System III came from Version 7, with a major enhancement to solve the problem of the fragile nature of the file directory structure, and that, when AT&T decided to release it as a product, they decided to come out with a new version, V, and that the people who were working on III didn't have the time to work on V, so a new development group started with 7 in an independent development.

Dennis: No, the split between us and the development area—in the sense that they stopped following us and actively taking everything we did—that happened *before* the 7th Edition. So that, the actual branch in the tree was not only before III, but before 7. It's not that we've stopped talking to each other; it's just that the very active collaboration stopped. System III has a very different I/O control structure for terminals. The development group decided to redo that, and we decided not to. So, V is their successor system.

Mark: What are the differences, specifically?

Ken: The terminal I/O is a different call, with different parameters.

Dennis: Theirs is logically a lot cleaner. It's also more complicated—there are a lot more bits, it has a lot more 'state.' They have tried to make a separation between input and output, so that the states of the terminal reading and terminal writing are somewhat separate. They have sort of unbundled it. Comparing the 7th Edition with System V, one is the sort of raw mode versus cooked mode, and cooked mode gives you carriage return/linefeed stuff, erase and kill processing, gathering in the lines, and so forth. In System V, there are some different options. For example, you can independently decide whether you want erase-and-kill processing and carriage return/linefeed sequences, and whether you want to get text back a line at a time or character by character. So, in some sense, there are details that I don't like about it—I don't like the fact that it's more complex—but, logically, it's an improvement over ours.

In practice, however, it *has* been an unfortunate thing. There really *are* only two areas where there are serious differences between the versions of UNIX—and that's one of them. It's just that, if you do something to control the terminal, you have to do it differently in System V than in the 7th Edition-derived versions, which includes Berkeley. So, that's one difference. The other has to do with external declarations in C. The C standard mess . . . well, let me tell you what it is: it's whether or not you can declare the same external variable in two different routines, without having to say 'extern' in one.

Ken: A clear distinction between reference and definition.

"The things that got put in UNIX were the things *we* needed."

Dennis: The whole issue is very, very complicated, because the book—the 'white' book—says that what System III decided to do is correct, and we never changed. We kept the extended version, and people kept depending on this, even though the book says you're not supposed to do it. System III said, "We're going to enforce this." In prac-

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Conversation

Continued from page 54

tice, that's been reversed. In System V, release 2—which is the current release—the rules are again the same as the ones we had. Those are the two main things.

Mark: Do you know why that decision was made?

Ken: It has do with, *mainly*, IBM mainframes, and going into *their* loaders. The way you have to declare externals for IBM loaders is with a common block, like in normal Fortran-type loaders, and that means some arbitrary small number. The C language actually changed to make it possible to do implementations for non-UNIX environments. And then, in our own group, we just didn't bother to *insist* that was the way it had to be. The development group, particularly when they were doing ports to other machines,...

Dennis: ...and, also for intellectual reasons, decided to follow the standard. They decided it was better, on two grounds: First, that it was better programming style to do it the way the book says—the fact that it *is* the rule. It caused a fair amount of pain, in various ways—programs that had to be changed—but it was not because it was unmotivated. Anyway, that particular issue is somewhat of a dead one, now, since the current rule is back to the original.

Chris: There seems to be a movement going on, at least among the user groups, to develop "standards" for UNIX. I don't know whether this has to do with programming styles or specific ways of doing things. What's your feeling about this development of standards?

Ken: Well, the group pushing for standards is */usr/group*, and their concerns are commercial. They want to be able to write software that runs on UNIX and be able to say, "If we follow the standard, and people who implement UNIX follow the standard, then all this stuff is going to match." It's a market-driven kind of thing. That's their charter—and they're right, in that sense. For a commercial marketplace, they need standards to adhere to. I gather the people who produce diskettes for CP/M have to produce 10 or 15 different versions, and UNIX people don't want that to happen. They want a standard so they can sell one version of their software that goes everywhere.

Dennis: On the other hand, they have to be fairly conservative. They're not really trying to solve the hardware problems, because there are just too many constituencies. There are basically two groups of people. One is the System V people, and one is the Berkeley 4.1 and 4.2 people. The latter is numerically not gigantic, but they are intellectually very, very important, because it includes all the colleges. The */usr/group* people can't simply come down and say, "It's got to be this way," because there are too many people who would want it another way. So, they are trying anticipate as much as possible, and record priciples that say, "Here's the way things are," over as large an area as possible. In other words, they are trying to *discover* standards, not to make them.

Ken: They're trying to find rules by which you can live within the existing systems.

Dennis: And, to the extent that they're doing that, AT&T seems to be quite happy to go along. The same is true, incidentally, with the C standard. Next week, they're meeting, and they're proceeding quite cautiously. Most of the changes in the manual that they have made are basically clarifications.

Mark: I still have lots of questions, but it looks like they're set up and ready for pictures...

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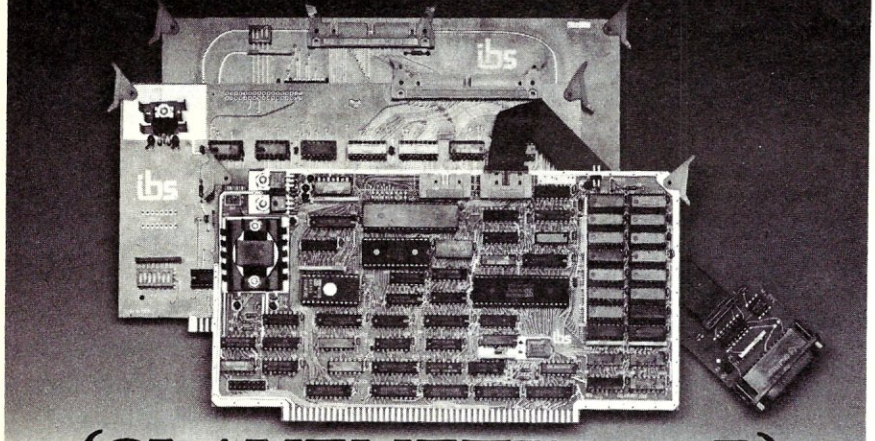

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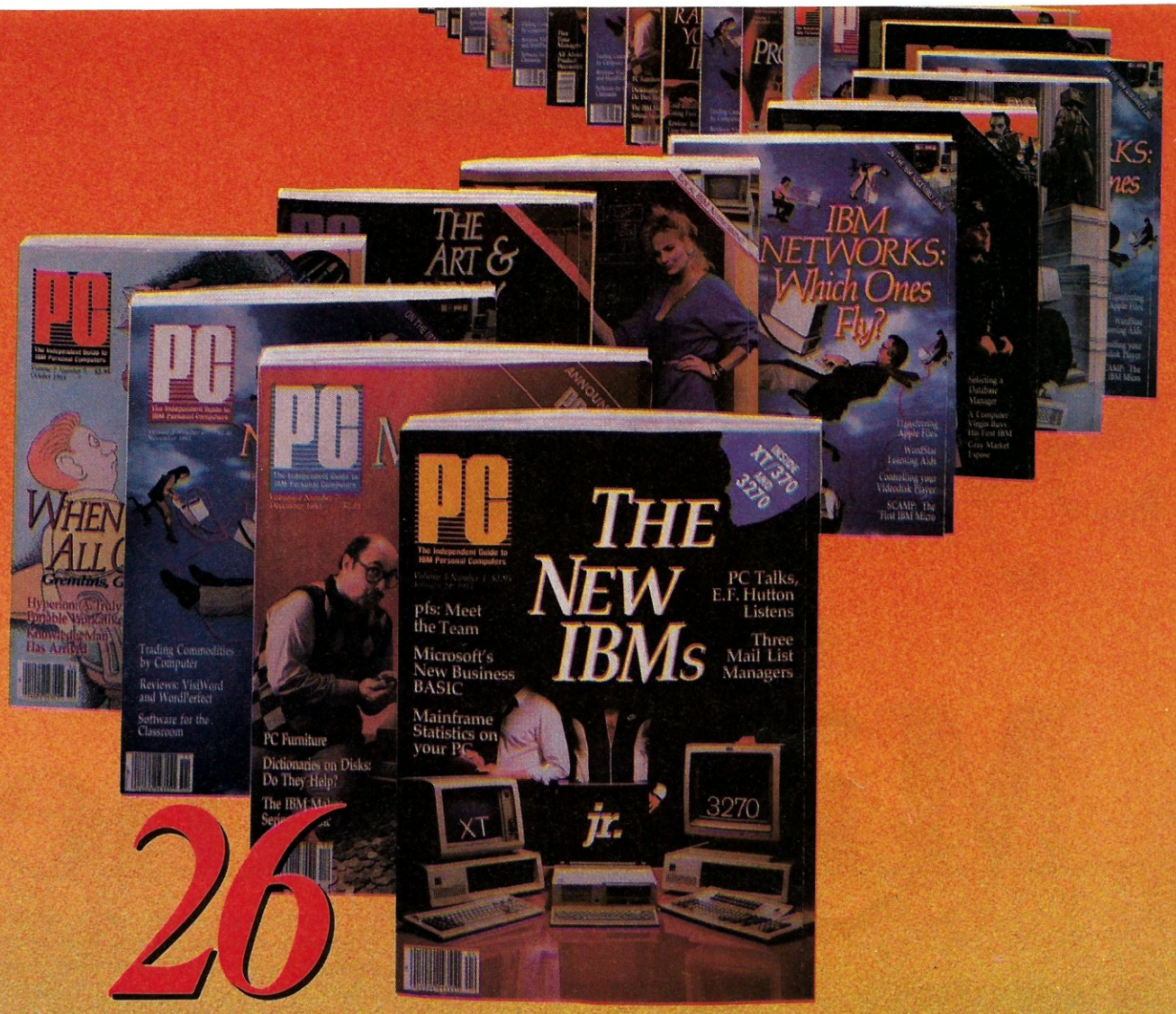

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Here is the story of how my company brought a Convergent Technologies' miniframe into the "household."

Selection criteria

Our requirements for a computer were probably more exacting than those of most organizations. We had been developing C programs for years on an Onyx, and were completely satisfied with it. In particular, the Onyx port of UNIX System III had proved more reliable than most other microcomputer ports. But, last winter, we began to do an increasing share of our work on the Prolog language. As a high-level interpreter, Prolog is a real memory hog. The Onyx, like the PDP-11s that first ran UNIX, is limited to a 128K split instruction/data program size. All too frequently, we would see the message, "malloc: out of memory" when a Prolog

program exceeded 64K. We needed memory, and we needed it badly. Since our programs showed no signs of getting any shorter, our first criterion for a new machine was virtual memory.

The next important quality we were looking for was a good port of a recent version of UNIX: System III or Berkeley 4.1 would be acceptable, System V preferable. There are a number of questionable ports afloat in the UNIX micro marketplace. While trying to use a number of these, we observed the following strange phenomena: (1) a machine that dumped core every time you tried to use the C library function, *gets()*, (2) a *mail* command that could not find any users on the system, and (3) a version of *awk* that added a few cents to dollar amounts, intermittently.

Our third criterion was the manufacturer's ability and willingness to support the product. It is all too often the case that a vendor will either not have any UNIX expertise in house, or not allow you to speak to the UNIX expert. Also, you often find that the people you call on the software support phone are friendly until your questions reach a certain level of complexity; then they try to convince you that you really don't need to know what you are asking about, or stop answering your phone calls altogether. There's no loneliness like the loneliness of realizing that the manufacturer of the machine you just bought has suddenly become empty headed.

Possible machines

The first machine to come to mind was a VAX/730 running Berkeley UNIX. (Until recently, Berkeley UNIX included virtual memory, while AT&T UNIX did not.) By the time all the options were added up, though, this looked like a $50,000 choice, which was prohibitive for us. Another alternative was a Sun workstation, featuring the first full port of Berkeley UNIX to a micro, as well as elaborate Lisa-like iconography, mice, etc. But, even with a hefty software developer discount, the Sun was a very expensive single-user machine. Furthermore, we sensed that the price had been boosted by graphics and other features which were not essential to us. A third possibility we carefully considered was the LMC machine based on a 16032 CPU *[recently renamed the 32016 for second-source contractual obligation reasons—ed.]*, with a port of Berkeley 4.1 from Human Computing Resources. This may be a very interesting machine someday, but at the point we examined it, there were still many bugs in the port, and LMC seemed to have inadequate inhouse UNIX expertise.

Just as we were starting to get discouraged, a sales representative from Four Phase/Motorola called and described an inexpensive machine based on a 68010, with System V, and, of all things, virtual memory. Where did this

We were looking for a good port of a recent version of UNIX—preferably system V.

mysterious machine come from? Convergent Technologies, the sales rep revealed. This was news to us. Convergent, the computer manufacturer's manufacturer, the company that made workstations, the Megaframe, and Workslate portable computers, was now making a small UNIX box? It sounded interesting.

Introducing the Miniframe

We began to ask questions. We consulted *netnews* on Usenet. Had anybody heard of this machine? Was it any good? Our initial inquiries produced little substantial information, but a number of intriguing rumors surfaced:

(1) The Miniframe runs XENIX, not System V;

(2) Convergent is advertising the Miniframe, but not shipping it;

(3) UNIX on the Miniframe is only an emulator, running on top of the native operating system, CTOS;

(4) Convergent has put a "user friendly" shell on top of UNIX, and it is impossible to get around it;

(5) Convergent has no real commitment to UNIX, but is offering UNIX in response to market pressures.

It turned out later, that all of these rumors were totally unfounded, and probably invented by people who like to chat about such things on the net.

Then, Convergent staged a demonstration of their two UNIX machines, the Miniframe and the Megaframe, in New York. This went a long way toward convincing everyone that these machines actually exist. At any rate, we were convinced. We met with a Convergent salesman, who qualified our company as an OEM, and placed an order for a development machine (with 1.5 MB of memory and a 37 MB hard disk) and a Convergent terminal. He promised 30-day delivery; we sat back and waited. Not all our computer colleagues shared our anticipatory glow. "I wouldn't buy a new machine," one of them said in an ominous tone, "until it had been out in the field for awhile. I'd wait until other people had found the bugs." 35 days later, it arrived.

Up and running

We opened the box and pulled out a small space-age unit, tower-shaped, lightweight, made entirely of plastic. Did it really have all the guts it was supposed to? Tilting and swiveling on its base, the terminal looked as though it had been lifted from the Jetsons' living room.

Three hours and twenty-seven floppies later, UNIX was loaded and it was time to boot. Flicking the spring-loaded reset button on the back, we watched Convergent's System V come shining through the console. Booting was entirely automatic and problem free. (Since this was the first time we had seen System V, it was not clear which remarkable features—such as automatic booting—were due to Convergent and which were part of System V.)

Out first reaction to the port was delight at the speed of such conventional programs as *ps*, *ls -l /etc*, and *vi*. For example, the Miniframe can run the entire *vi* program. (It has been abbreviated on many machines that are restricted to a 64K instruction segment.) When editing a long file, *vi* moves from the beginning to the end of the file in a split second.

One reason for the appearance of speed is that the Convergent terminal plugs into the machine through a high-speed serial interface, an RS-422 port. Up to eight terminals can be daisy-chained from this port. Any program which is I/O bound (such as *vi*, which refreshes the screen often) appears much faster when you execute it on a Convergent terminal.

Some people have voiced the criticism that, when you buy a Convergent terminal, you are locked into buying Convergent computers because RS-422 is not yet an industry standard for terminal I/O. But, look at the situation in another way: most small UNIX machines work very slowly as multi-user machines because each RS-232 port generates frequent hardware interrupts. However, the Miniframe's 422 port connects with the memory bus not through a serial I/O chip, but through direct memory access. Since terminals are dai-

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Miniframe

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sy-chained off one RS-422 port in the Convergent design, there are fewer interrupts. The Miniframe is equipped with two RS-232 ports, and an expansion board is available with eight additional RS-232 ports.

The hardware: pro's & con's

People have reacted in a variety of ways to using the Convergent terminal. One friend who inspected it complained that the keys had been both mislabeled and misplaced. The most grievously befuddling examples of mislabeling are the 'control' key, marked 'code,' and the 'escape' key, marked 'go.' (Perhaps in California, where Convergent is based, people do not escape, they just go.) These idiosyncratic key names seem to be part of Convergent's style; the Workslate, another Convergent machine, features a key that is labeled, curiously, 'do it.'

We have no complaints about the computer itself. We were happy to discover that the RS-232 ports can handle *uucp* (UNIX-to-UNIX copy program) communications between machines at a 4800 baud rate, without losing any characters. (*/uucp* under System V is considerably improved from earlier versions.) Many other small computers advertise a baud rate of 9600 on terminal ports, but can attain this speed only with a relatively slow typist on the terminal. If you really send data at 9600 baud, as *uucp* does, chances are you will begin to lose characters. 1200 is usually a workable communications speed for small UNIX machines, so we appreciate the fact that the Miniframe works at 4800.

The Miniframe can run the entire UNIX *vi* program.

Evaluating the software

For some reason, we failed to anticipate that there would be a "list of bugs" in the software release that came with the machine. We were aware that other people who bought small UNIX machines had to put up with bugs, but this was our machine, so shouldn't it somehow be perfect? Happily, though, Convergent's 2.0 of their System V arrived within three weeks, containing corrections for most of the bugs in the earlier release. For instance, it is now possible to format a floppy disk, mount a floppy disk as part of the file system, or use a floppy disk as a *tar* (tape archive) device.

The new version also offered C-Shell, giving the AT&T System V a Berkeley flavor. We found two obvious bugs right away, in the *alias* mechanism, and in the C-Shell's ability to reference environmental variables. The C compiler and *make* utility worked without a hitch, and one of the first things we did was recompile the C source of the Prolog interpreter. Prolog runs very quickly on the machine, and we have not yet run out of memory.

No AT&T version of UNIX before System V.2 included virtual memory, so the virtual memory implementation on the Miniframe is Convergent's own. Without virtual memory, UNIX swaps

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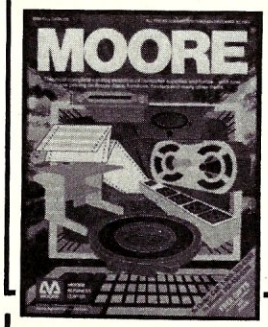

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Miniframe

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whole processes out to the disk when it needs to make room for new ones. But, with virtual memory, UNIX moves 4K 'pages' of each process back and forth to the disk as they are needed. The Miniframe has a 2 MB swap area on the disk, which means that it should be able to use something like 3.5 MB (1.5 MB of physical memory + 2 MB of swap space) before it runs out of memory. However, where the System III kernel (the core resident portion of the OS) took 110K, the System V kernel requires 256K.

Building a LAN with the Miniframe

Once the Miniframe was running, other uses for it came to mind. We decided to pool resources with a colleague with whom we share office space. Using *uucp*, he created a LAN in which the Onyx calls up the Miniframe every 10 minutes. This greatly facilitates file transfers and electronic mail between the two machines. Then he added a laser printer to the system, hooking it up to one of the Miniframe's RS-232 ports. The laser printer makes beautiful copies and can be driven directly by the UNIX utility, *troff*. But the fonts for this printer use almost 60% of the Miniframe's 37 MB of disk space.

But does it crash?

Thus, between the terminal, *uucp*, and the laser printer, the Miniframe gets a hard workout all day long. Nevertheless, the system has never crashed in the usual sense of the word; instead, it automatically reboots. We found that this automatic rebooting happened frequently while running *uucp* (at high speed) simultaneously with *vi*. (Whenever this happened, the system politely saved a copy of the program being edited in a file called */tmp*. It was retrievable with the *-r* option of *vi*.) This problem disappeared with release 2.1 of the operating system.

Vendor support

Our third criterion in selecting a machine was vendor support, and in this respect, Convergent's performance has been excellent. We get quick service and feel as though we are talking to real UNIX people on the other end of the phone, rather than mere telephone personalities.

We have yet to try out all the features of the Miniframe's System V. In particular, we're looking forward to exploring shared memory for multiuser Prolog databases. (We'll let you know how that works out in a future article.)

Conclusion

Yes, life in our house has definitely been enhanced by the Miniframe. The port of System V is sound, and its remaining bugs are being eliminated rapidly. We received a greatly improved release, 2.1, two weeks ago. Moreover, we may not be the easiest "family" to please. Despite the demands we make on the Miniframe, however, it runs faster than any other system in the same price range. All in all, we're happy with our big decision.

Note: the Miniframe is available from a number of dealers and OEMs nationwide, including Four Phase/Motorola and Gould. The list price of a minimum system (512K of memory, 10 MB disk) from some sales organizations is about $8000.

For information on the Miniframe, contact *Convergent Technologies, 3055 Patrick Henry Drive, Santa Clara, CA 95051. (408) 980-0850.*

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8085 XASM	99.50	500.00	99.50	99.50	99.50
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IBM PC/IX

Standard UNIX runs better than you think for the PC

by Peter Brooks

The battle of the titans has spread to our backyard. AT&T, formerly the world's largest private company in terms of employees, and having arguably the world's best research and development arm (Bell Laboratories), announced an IBM PC-compatible micro in June. In the same month IBM, the world's most profitable private company, delivered PC/IX, a UNIX system for its PC and PC XT. This is the first skirmish in microcomputers by the giants, with more to come soon.

For those needing more software power than PC-DOS delivers, the new crop of UNIX offerings provides the tools to build large and complex systems. All the traditional strengths of UNIX—machine independence, timesharing, modular design, abundance of simple tools and an 'open' software architecture—have now been brought down from the minis to serve microcomputer users and software developers. And the late 1970's generation of university programmers who grew up under a UNIX environment because Western Electric used to give it away for practically nothing, have now entered the industry and brought their love for UNIX with them. They continue to communicate over an active network of UNIX electronic mail system connections that carpet the country.

PC/IX (Personal Computer Interactive Executive—some people will go to great lengths to obfuscate an obvious acronym) was developed by Interactive Systems Corporation to be marketed exclusively by IBM as a single-user version of UNIX (see sidebar). This is a solid product, with all of the familiar software development tools that UNIX programmers have treasured over the years.

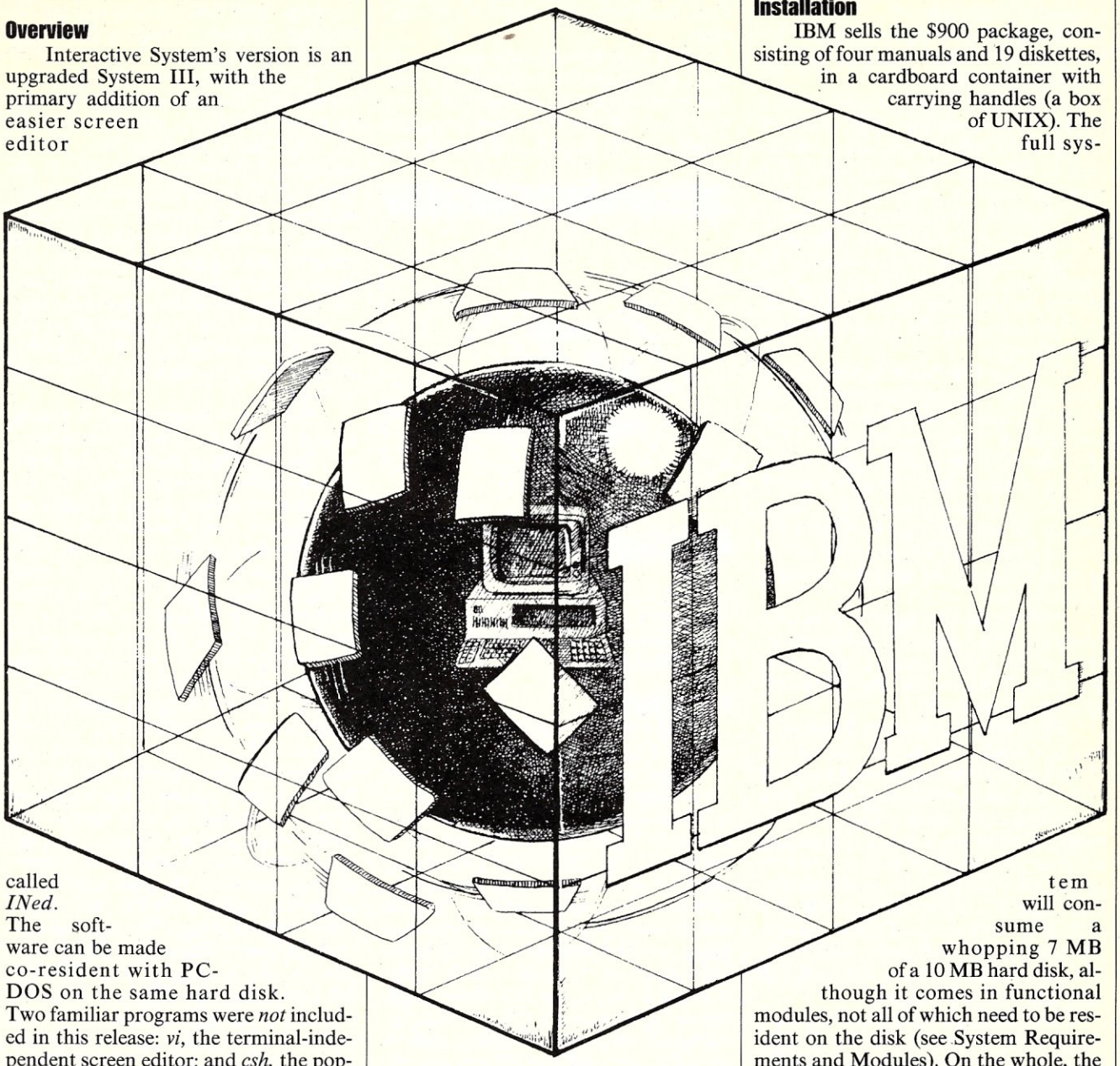
Even without a direct AT&T offering, the competition in micro versions of UNIX has already heated up. Based on Bell Labs' UNIX System III, PC/IX will be in head-to-head competition with XENIX from MicroSoft (which is also based on System III), VENIX/86 from VentureCom (based on Version 7), and a variety of UNIX look-alikes for the PC (QNX from Quantum Software, Coherent from Mark Williams, IDRIS from Whitesmiths). While UNIX System V is the most advanced version of the operating system on the market, and heavily marketed by AT&T, IBM presumably chose System III because it

had been out in the field for years and had been extensively tested.

Overview

Interactive System's version is an upgraded System III, with the primary addition of an easier screen editor called *INed*. The software can be made co-resident with PC-DOS on the same hard disk. Two familiar programs were *not* included in this release: *vi*, the terminal-independent screen editor; and *csh*, the popular C-shell. Rumor has it that IBM is expected to release these products in a future version, but for good reason did not believe that *vi* was necessary in a single-user UNIX environment alongside *INed*. The omission of *csh* was probably for reasons of space.

One of the reasons for the great success of the PC was the decision to publish the internal hardware specifications and the contents of the ROM BIOS. This generated an entire industry of hardware and software developers who knew virtually everything they needed to know about the machine. With PC/IX, IBM has again implemented their 'open architecture' design philosophy. They provide both the required software and tutorial help for implementing new device drivers.



The traditional strengths of UNIX have been brought from minis to micros.

Installation

IBM sells the $900 package, consisting of four manuals and 19 diskettes, in a cardboard container with carrying handles (a box of UNIX). The full system will consume a whopping 7 MB of a 10 MB hard disk, although it comes in functional modules, not all of which need to be resident on the disk (see System Requirements and Modules). On the whole, the documentation is better than for any other UNIX system I've seen, with very good tutorials, articles, and modification suggestions.

The most important decision in installation is: how much of the hard disk are you willing to allocate to PC/IX, and how much to PC-DOS? The two systems can be made co-resident only by allocating fixed areas of the disk to each. Therefore, if you had installed PC-DOS without the expectation of using the disk for anything else, you will first have to back up all of your files onto floppies, split the disk into partitions of predetermined size (erasing all information from the hard disk), and reload your PC-DOS files into the PC-DOS partition. After installing both systems, you can

Continued from page 67

switch between the two very easily, although only one system can be running at any given time.

An area of 6-8 MB is recommended for PC/IX, depending upon which of the optional software modules you expect to use and how much space you need left over for your own files. You can, of course, allocate the entire disk to PC/IX and run PC-DOS from floppies, or alternatively purchase another 10 MB hard disk (which should speed up PC/IX multitasking operations significantly by locating the swap area on a different disk).

Once the disk has been partitioned, there is a 24-step installation procedure to load the core system that takes about half an hour. Then, one can load any or all of the optional modules (see box on Software Modules). It takes about 2 hours to accomplish a full system startup for someone who has done it before, and not much longer for the rest of us who like to know what we're doing along the way.

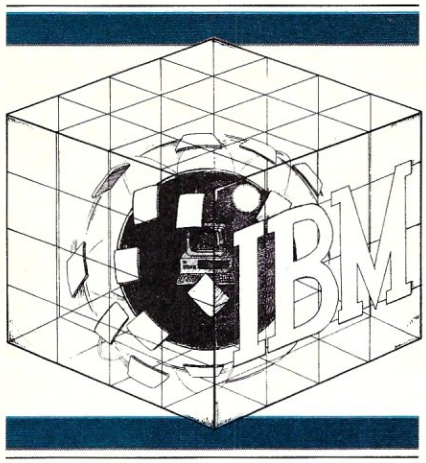
Although the documentation doesn't mention how, the license agreement allows the creation of backup diskettes. It turns out that PC-DOS' *diskcopy* works nicely.

Since the programs are designed to run on a single 10 MB disk, and the full 19-diskette system swallows at least 6.4 MB, IBM has carefully broken the programs apart into subsets. The *core*, consisting of all of the commonly used and necessary commands plus the editor, comprises the minimum usable subset. It takes up 1/3 of the disk (3.4 MB), not including user space, and allows the system to perform virtually any small task. The rest of the subsets are optional, and can be loaded at any time.

Of course, any serious development work would probably require at least the C compiler, and its associated utilities like *lint*, the C program checker, *adb*, the debugger, and the function libraries, all of which are contained in the programming subset. This is the largest of the modules, taking up 1.3 MB on four diskettes.

The communications subset contains the powerful UNIX file transfer and terminal programs, and the unix-to-unix mail facilities. The source code control system module consists of programs to track versions of files that change often. With the text processing subset, the user receives the UNIX text formatting languages and filters: *nroff*, *tbl*, *mm*, etc. In addition, the special-purpose module provides the programs for actually typesetting materials. With system accounting installed, the operating system will keep track of logins, disk, printer and CPU usage, and produce summary reports on a periodic basis.

The final subset is the games, presumably intended to keep the programmer busy while the machine is doing real work. While the chess program (rated class D player) is not included,



tic-tac-toe, backgammon and blackjack might keep the user amused, along with a multitude of quiz programs and fortune cookie sayings.

Documentation

The four manuals included should serve as a complete guide to the system.

Beginners can start with the Text Processing Guide, which includes a tutorial on the file system and the use of the basic commands. Most valuable is the tutorial for *INed*, with step-by-step instructions on the creation and editing of simple documents and files. Besides the tutorials, and the INed reference guide, all other documents in this manual are reprints from the UNIX literature: guides to *ed*, the line editor; *nroff*, the text formatter; *troff*, the typesetting formatter; *mm*, the formatting macros for *nroff* and *troff*; and *tbl* and *eqn*, filters to create tables and mathematical equations in documents.

The System Manager's Guide is especially well done, with explanations of setting up ports for communication, doing system accounting, adding users, and figuring out the line printer spooler. Care and feeding of the file system is covered in detail. Various types of modems are already supported by the system (Hayes Smartmodem 1200, VenTel MD212-Plus and DEC DF03), and help is provided for setting the switches and creating autodialer programs. Since there is very little difference between the communications programs that IBM provides and the standard complement of UNIX networking tools, the manual includes reprints from the UNIX literature by the authors of these tools. And for the intrepid, there is a guide to writing device drivers and embedding them into the operating system.

The Programmer's Guide, a fat volume of 250 pages, contains chapters on all of the major programmer's tools: the shell; the C language; *lint*; the assembler (as difficult to use here as on other UNIX systems); the debugger; *make*; *sccs*; *lex*; and *yacc*; the macro processor, *m4*; the stream editor, *sed*; the pattern scanning language, *awk*; the terminal-independent screen library, *curses*; and the desk calculator languages, *bc* and *dc*. Virtually all of the material comes from UNIX reprints, usually from the authors of the tools themselves.

The User's Manual uses the same format as all other UNIX User's Manuals for describing the billions of commands available on the system. The explanations are terse and often difficult to figure out, even if you are used to the style. The format is at least honest, with a subsection of each command devoted to known bugs. Since there is no online version of the manual (as there is on most large UNIX systems) because of the shortage of disk space, the written version becomes especially important.

All told, the documentation is reasonably complete; nevertheless, I defy anyone to master system accounting without extensive experimentation (the following note appears at the beginning of the accounting section of the manual: "No manual can take the place of good, solid experience.") Despite the volume of print thrown at the purchaser, some important topics were left out. There are no indexes in any of the manuals (except the User's Manual), and no discussion on how to make backup diskettes from the originals. There is a crying need for some sort of map of the file system—where things are—since a fully loaded disk contains 700-800 files spread over 80 directories (Figure 1). Finally, there is no introductory discussion of what most of the tools do, or how they fit together. On the other hand, there is much more here than is normally provided to a UNIX user.

Performance

As one would expect, a large machine system brought down to the microcomputers will suffer performance degradation. PC/IX is no exception. The PC's processor is slow, the hard disk is slow, and the software speed matches the hardware. As a single-user system, however, the performance is quite acceptable. Even with processes executing in the background—provided they are given low priorities—the user

will not be left waiting.

Some of tools, like *awk*, the C compiler, and the text formatters, can drag the system to a crawl. Unfortunately, one of the worst offenders is Interactive System's editor, *INed*. It takes 10-15 seconds to invoke each time, even with a small file. Fortunately, because of the editor's design, one does not need to call it from scratch each time a file needs revision (see the discussion below). Most of the ordinary tools perform much faster.

With multiple users, the story is different. Each person knows the load they have placed on the system, and will compensate psychologically for degraded response if a large request has been invoked. However, if others also make requests, then the response is unpredictable, especially if it is slow. With such a small machine, each new task takes perceptible time away from other tasks, particularly interactive ones, and the user can feel the difference. Microcomputer users, spoiled by having entire machines dedicated to their whims, may be loath to give up such pleasures for the unknown benefits of timesharing.

INed—the screen editor

Ined is the primary addition to this otherwise standard UNIX System III implementation, and appears to be a descendent of an older Interactive Systems editor called Ned. It's programmed to interact directly with the PC's video RAM, making visual updates much faster, but also making *INed* impossible to use by any device other than the console (see sidebar on single-userhood). The system administrator should ensure that anyone else logging in be prevented from using *INed*, because the console screen will go haywire!)

INed is easier to learn from scratch than *vi*, because many of the simple commands, such as cursor movement, are dedicated to appropriate special keys on the keyboard. Besides the tutorial and the reference manual, there is online help for each of the commands, and a small plastic map of the keyboard to be placed near it for reference.

All of the standard text editor functions are available: change tabs and margins, center, search and replace, move text blocks and columns, format with or without right justification. While most of the simple operations are fast, both scrolling and searching can be somewhat slow. The screen mimics a blank sheet of paper better than in *vi* or WordStar, and the cursor can be moved anywhere on it without regard to previous 'end of lines' and other hangups. The cost of this blank sheet approach is that it is as hard in *INed* as in *vi* to split a line or join two adjacent lines together.

Comparison of major programs with UNIX System III

Added	
dosread	
doswrite	PC-DOS utilities
dosdir	
dosdel	
e	INed visual editor
format	Format diskettes
Included	
acct-	System & user accounting tools
adb	C program debugger
ar	Archive and library manager
as	8088/6 assembler
awk	Text processing language
bc & dc	Desk calculator utilities
bs	Basic/Snobol interpreter/ compiler
cc	C compiler
curses	Screen management library
ed	Line editor
ld	Link editor
lex	Lexical parser
lint	C program checker
m4	Macro processor
mail	Send mail
make	Program module maintenance
mm	n/troff macro library
n/troff	Text formatters
prof	Program profiler
sccs	Source code control system
sed	Stream editor
sh	Bourne shell
sno	Snobol interpreter
sort	Sort and merge
stty	Set terminal characteristics
uucp	unix-unix copy
yacc	Compiler-compiler
Omitted	
csh	C-shell
f77	Fortran 77
man	(no manual pages online)
ms	n/troff macro library
tar	Tape archiver (no tape utilites)
vi	Visual editor

INed supports multiple editing windows, cutting the screen either vertically or horizontally, and you can easily pick up text in one window and plant it in the other. You can sequentially edit files without leaving the editor.

A fancier feature is the ability to run programs (filters) on all or a portion of the file that you are currently editing. For example, you can request, while in the middle of a file, that the next 27 lines of text be sorted. *INed* will call the *sort* program and replace the next 27 lines on the screen with its output. Virtually any other filter will work the same way. This mechanism can be used to extract a portion of the current file (using *cat* as a filter), eliminate selected parts of it (using *grep*), even format it, using *nroff* (although there are quicker ways of doing simple formatting). As you become more familiar with the powerful UNIX text manipulation programs, you can watch them work dynamically on the text in front of your nose.

As with other UNIX editors, you can escape to the shell in the middle of editing a file. *INed* will save the file before creating a new shell, so it can be compiled or manipulated in other ways. Exiting the shell will pop you back into the file where you left it. Therefore, you never need to exit the editor. You can also ask the editor to run a program and put its output into a box on the editing screen (*popbox*). Thus, you can ask for the date without having to take your eyes off the text, or run a telephone program that will dial someone, given the person's name.

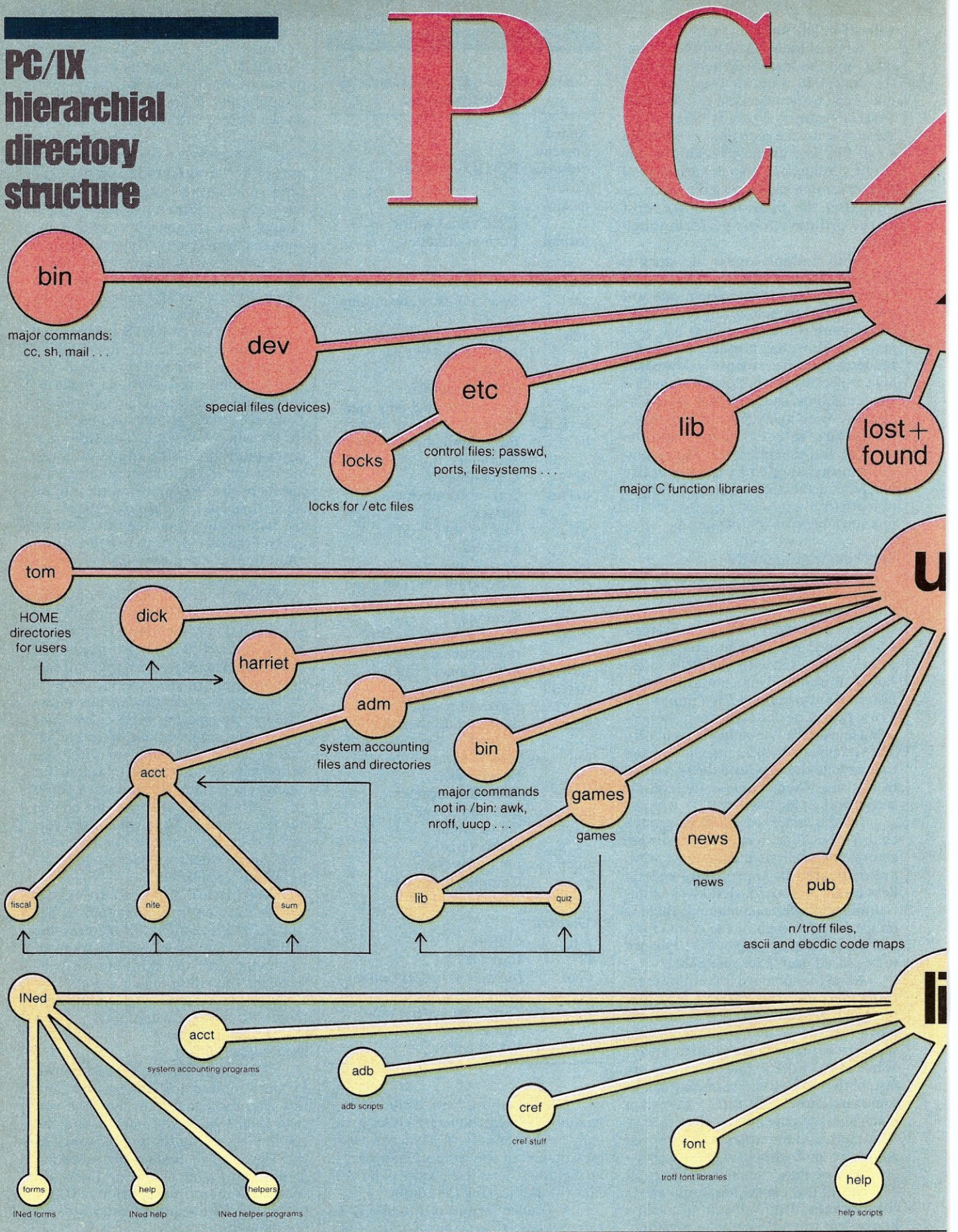
There is also a configuration file that will allow some degree of customization of the editor. Help menus can be changed to suit your needs, and active menu items inserted that will execute programs or shell scripts. Once installed, you can select the menus at any time by touching the MENU key. One of the interesting features of the configuration file is a reminder service. The editor can be instructed to watch for changes in certain files and warn you if any occur (a box will pop up on the editing screen). Thus the editor can check every few minutes for incoming mail, or see whether a background task has finally completed.

INed is much more suited to a workstation environment than *vi* because of these configurable features, the multitude of special keys, the speed of response, and the documentation. Teaching this editor to new users will be a much kinder task than confronting them with the obscurities of *vi*.

Communications

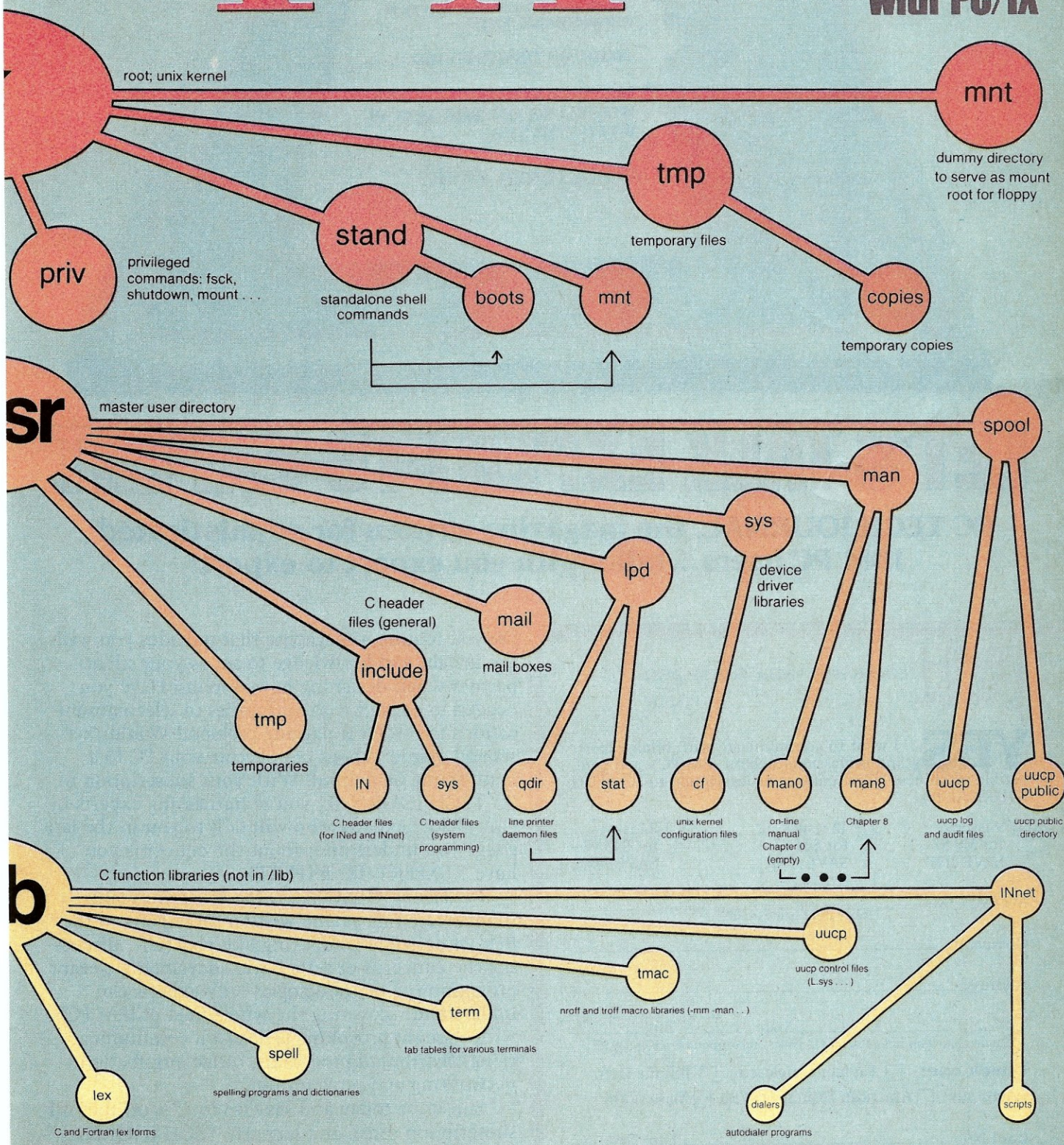
UNIX systems have been known for their communications prowess, and this one is no exception. Even as you read this, UNIX systems around the country are exchanging mail, transferring files, and requesting the execution of programs over telephone lines—all without human intervention. PC/IX has all of these communications capabilities built in.

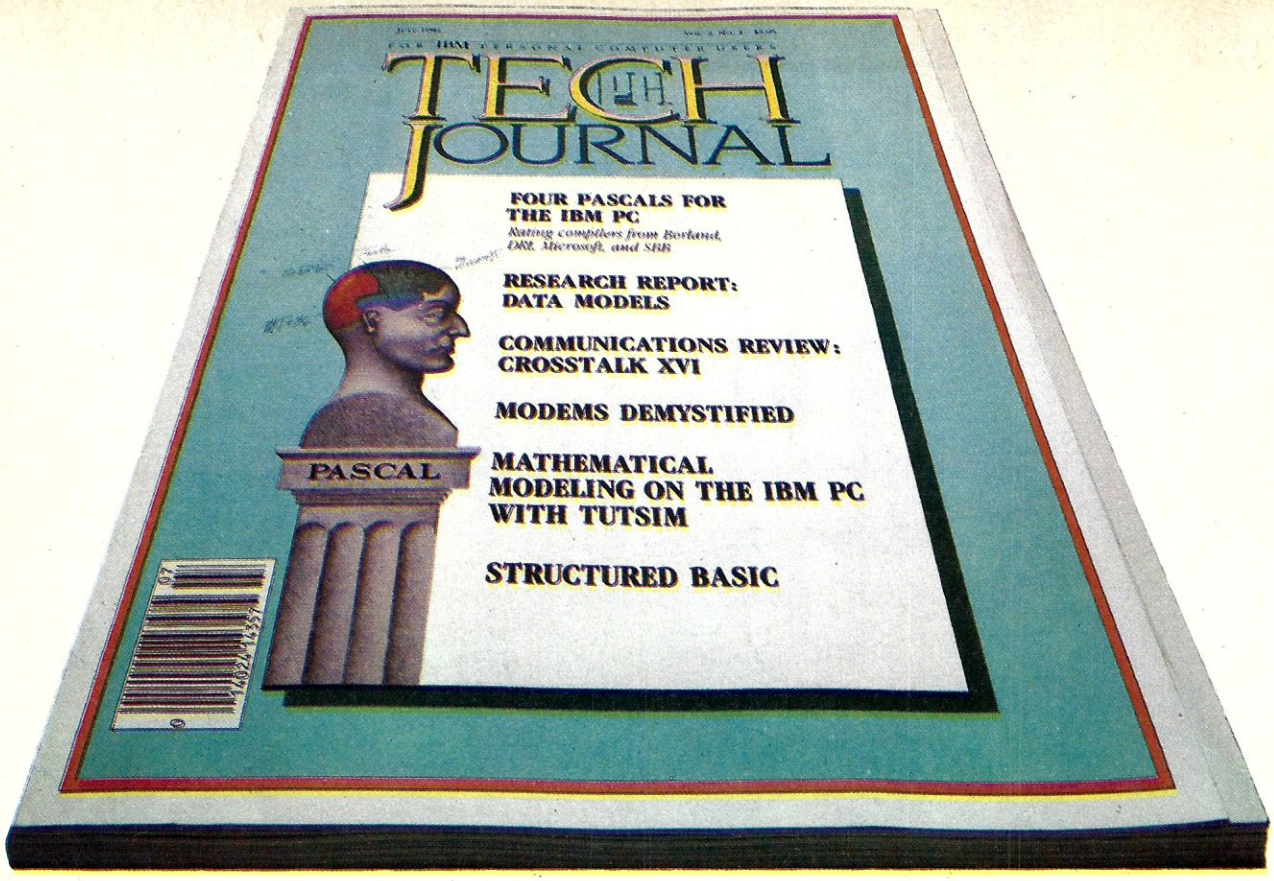
PC/IX hierarchial directory structure



IX

Layout of the file delivered with PC/IX

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PC/IX

Continued from page 69

The simplest communications are established with *connect*, a dumb-terminal program. There is a handy configuration file which allows *connect* to use the auto-dialing mechanism of some modems to call a particular system by keyword. Thus, if you execute

```
connect oval_office
```

and you have an entry for *oval_office* in the configuration file with baud rate, phone number, etc., then there's some chance of connecting to the President's computer (don't tell him I sent you).

The powerful communications front-end program *uucp* allows the copying of files between machines. As with most other complex programs on UNIX, the workings of *uucp* are controlled by text files, governing abbreviations for other machines; how to reach them (phone, hardwire); when to reach them (middle of the night when the phone rates are low); how to log in, etc. Once the information about a remote site has been deposited into the control file (this need be done only once, and can be altered on demand by the system administrator), it can be retrieved by abbreviation.

To give an idea of how this works, let's suppose I want to transfer a file 'top-secret' to another directory, /usr/george, on my own machine; the command would be:

```
cp top-secret /usr/george
```

If George has an account on the Pentagon computer, I can transfer the file to his directory on that computer by:

```
uucp top-secret
        Pentagon!/usr/george
```

For multitasking on the IBM PC, UNIX is the system of choice.

Thus the invocation of the inter-machine copy program looks virtually identical to a local copy request. The copy program will look up the abbreviation for *Pentagon* in the control file, and find that that machine should only be called in the dead of night, with a particular login ID and password.

It will then stash the job away until the appropriate time to call, and when it does call, it will keep an account of whether it succeeds or why it fails—all without necessitating human intervention. And if it fails, it will try again. Of course, one can also request files to be transferred from remote machines to one's own machine!

Built on top of *uucp* is inter-machine mail. It looks, smells and tastes just like sending mail to other users on the same machine, but instead of

```
mail george <top-secret
```

we send inter-machine mail with:

```
mail Pentagon!george <top-secret
```

The mail program will notice that it should be worrying about inter-machine communications, and will pass the job on to *uucp*, which will do its dance of looking up *Pentagon*, etc. Meanwhile, the sender can go on to other tasks. It is even possible to request that the mail be passed through intermediate machines on the way to a final target (this is useful if there is a cluster of machines with hardwired communications, but only one of them has access to outside dialin or dialout lines). Indeed, one can get very fancy.

Last, but not least, there is inter-

A Single-User UNIX?

No. This is definitely a multiuser implementation of UNIX System III. Although IBM markets the product to be installed as a single-user (but, of course, multitasking) configuration, it is relatively simple to bring it up in true multiuser mode. Those who know UNIX will recognize that any system which has the capability to run both incoming and outgoing **uucp** must have ordinary login procedures.

There are enough hints in the documentation—and, there is even code in configuration files that simply needs to be uncommented—to activate one or even two login ports. (In particular; the only file requiring modification is */etc/ports*, wherein the devices, */dev/tty0* and */dev/tty1* can be enabled for login. The *Operations Handbook* is quite clear on how to do this.) There is also help for configuring modems by several manufacturers for both auto-dial and auto-answer.

There are several reasons why IBM might be shipping the product as if it were only single-user. First, there is the official IBM reason (from Nadine Fletcher of the Information Systems Division): they would never put out a multiuser system without memory protection. Anyone writing in assembly language has free access to all of the physical memory of the 8088 and, therefore, to the operating system code. This makes security hard to enforce, since it is very easy to crash the system using assembler. IBM's official line (according to Ms. Fletcher) is that they will support PC/IX only in single-user mode, but purchasers of the system can do whatever they want.

Another reason for single-user: they have to pay AT&T significantly more in royalties for multiuser sublicenses. Finally, they may feel that the PC's 8088 running at 5 MHz does not have enough horsepower to support more than one user adequately, and do not want to encourage the buyer to expect otherwise.

IBM chose a particular type of screen editor to emphasize the single-userhood point. Since they did not expect other users to be logging in, they didn't need a terminal-independent screen editor like *vi*; in fact, Interactive Systems built an editor that interacts directly with the IBM video RAM (*INed*). Thus, not only is *vi* missing, but if an external user attempts to execute *INed*, the result is screen output to the system console! Consequently, it is strongly recommended that external users be prevented from using *INed*. For them, there is always the trusty—but unfriendly—line editor *ed*.

Then, the legal question with respect to AT&T arises: can one legitimately use PC/IX configured as a multiuser UNIX? There is nothing in the manual on such restrictions (in fact, the *Operations Handbook* is clear: "Assuming a port has been made to work as a device, there should be no problem enabling it for logins.") The license agreement simply prevents one from using the software on more than one machine at a time (!). This not only seems to permit multiuser usage, but even multimachine usage (provided only one machine is going at a time). The implication clearly is: if you want to, you can. I'm sure that if the product becomes very popular, AT&T will have something to say about this.—*Peter Brooks*

Continued from page 73

machine command execution (*uux*). One can request that a command, or sequence of commands in a shell script, be executed on another machine and that the output be sent back. This is similar to batch submission of jobs to mainframes, except that one can send this request to any other UNIX machine!

Now, this may all seem a bit fast and loose in terms of security. The fact is, that each system is as secure as its passwords. If you cannot log in on a remote system because you don't know any of the passwords, then neither can your local communications programs do that job. In other words, *uucp* cannot transfer any files to or from a remote system which needs passwords that it does not have. Furthermore, UNIX systems can limit the type of jobs they will execute for other systems (via *uux*). All of these limitations and capabilities are contained in a few control files edited by the system administrator—easily changeable, very powerful, yet quite secure.

Languages

Naturally, the system comes with a C compiler. I have had no problems porting code to PC/IX, and large modules have been created automatically with *make*. It is difficult to benchmark the performance of the compiler, since there are few UNIX systems as small as this one. See Figure 1, however, for the results on the Sieve of Eratosthenes, an apparent de facto comparison, since it has been run on over a hundred computer systems (see Gilbreath: "Eratosthenes Revisited," *Byte*, Jan. 1983).

The IBM PC's processor architecture can make life difficult for your average C compiler. The 8088's memory segmentation, which deals with objects of up to 64K easily, has to work quite hard to deal with larger ones. Currently, the C compiler cannot handle very large programs—those whose code space or data space is larger than 64K. The linker/loader can separate data and code spaces into 64K each, yielding program sizes up to 128K, and can produce shareable code. Anyone interested in writing truly monstrous programs will have trouble, since the loader does not have the capability to generate overlays. One possibility is to split a large program up into separate, smaller programs called sequentially, or into simultaneous processes connected by pipes. There are other C compilers for the PC which can handle larger programs (e.g., Lattice C under MS-DOS); however, I don't know whether they run under PC/IX yet.

All of the standard System III C programmer's tools are here: *lint*, the C program checker; *cref*, which makes cross-reference listings; *adb*, the symbolic debugger; *cb*, the C program beautifier. The assembler, like most other UNIX assemblers, has sufficiently inadequate documentation to discourage usage. The only way to learn it is to analyze the assembler code output of the C compiler.

INed is easier to learn from scratch than _vi_, because many simple commands such as cursor movement are dedicated to special keys.

There is an interactive compiler/interpreter called *bs* which combines features of both Basic and SNOBOL 4. It includes structured flow control (if..then..else, for/while .next), mathematical functions, undimensioned string variables, regular expression pattern matching, and file access. Like Basic, it can be used as an interpreter, where a line of code is executed as soon as it is typed in; or a program written in *bs* can be compiled for faster execution. It was designed for quick jobs where shell scripts don't have the necessary flexibility, and the full C language is overkill.

The developers of UNIX had a preoccupation with the preparation and manipulation of text files. Hence, many of the algorithmic languages shipped with PC/IX are dedicated to the transformation of textual files. The foremost of these is *nroff*, the text formatter. This is actually a full-blown formatting language, complete with user-defined macros, although a prepared macro library, *mm*, is provided for normal use. The macro library *ms* is not included, for unknown reasons.

If high-quality output is desired, the phototypesetting formatter, *troff*, takes the same input as *nroff*, but can drive a variety of typesetters. For instance, a mere $10,000 will buy an IMAGEN laser printer/processor that will take output from *troff* and print camera-ready copy in a variety of typefaces and sizes.

Along the lines of text manipulation languages, there is an interpreter/compiler called *sno* which is similar to SNOBOL 3, with some limitations. The pattern scanning and processing language, *awk*, is extremely useful for text table processing, as well as for a myriad of other small jobs. A more powerful and difficult tool than *awk* is *lex*, a lexical parser useful in combination with *yacc* (yet another compiler compiler), which will actually generate a compiler for a user-defined language. In fact, *awk* was created using *lex* and *yacc*.

There are more tools and small languages on the system than can be described here. However, no major programming languages except *C* are shipped with the system. In particular, **f77**, the Fortran-77 compiler, is missing (possibly because the compiler is too large for the PC?).

I expect that a variety of compilers will migrate to PC/IX shortly. IBM expects to offer **INFort**, a Fortran compiler for $250, in July.

Special features

There are a few tools built specifically for PC/IX: utilities for reading, writing, and deleting PC-DOS files on either the hard disk or floppies, and viewing PC-DOS directories. A special misfeature is the necessity to bring the system down—into a state known as the 'standalone shell'—simply to format diskettes.

There is a safer form of the file deletion command, *del*, which requests confirmation before erasing anything (this can be a lifesaver). Error messages from the system are printed in highlighted characters on the 25th line of the console, which does not scroll off. This is a good practice, since these messages can occur during periods of heavy screen traffic.

Support

You are likely to find very little support from your neighborhood software dealer (including the local IBM product centers). The product is too large and complex, and the dealers seem to know virtually nothing about UNIX. Your first job is, therefore, to convince the dealer that you want to talk directly to IBM, and that he should be able to find ("I'm sure it's around here, somewhere...") and give you the 800 num-

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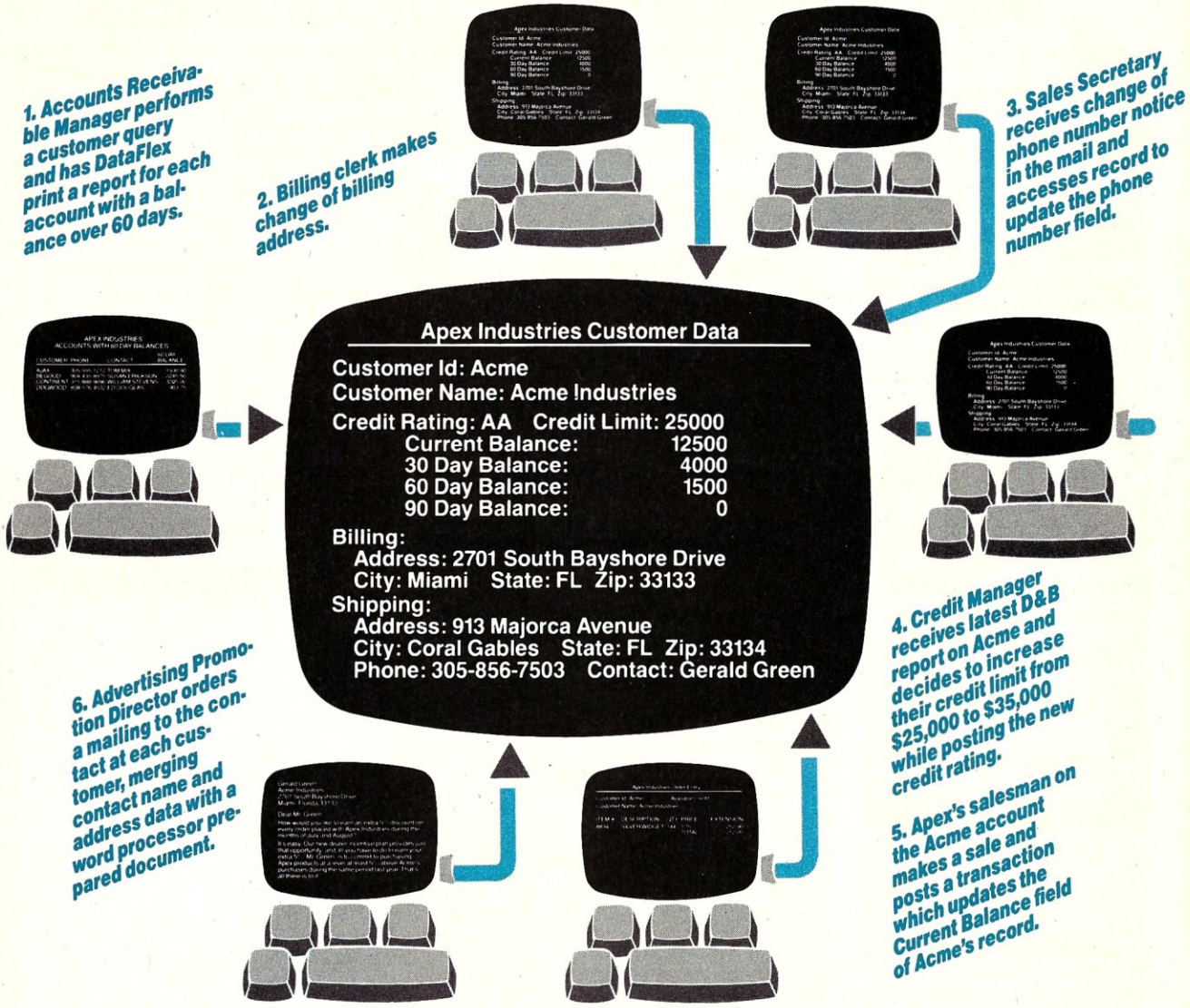
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PC/IX

Continued from page 74

ber directly to IBM's PC/IX product support group in Texas. *(Purchasers of PC/IX are entitled to the 800 number; however, IBM has made the dealer responsible for providing it. If you need support, make sure your dealer provides the number—Editor.)*

The folks in Texas are still easy to reach (as of this writing), and are quite friendly. They have a sort of triage system, where the person who initially receives your call will try to rate the severity of the problem. There is a scale from 1 to 4, with 1 being 'system-threatening' (it's down and you can't get it started), to 4 which is 'informational' (why did they leave out the chess program?). Problems of type 1 and 2 should get immediate response, with decreasing attention paid to 3 and 4. They also have a database of problems, and keep track of solutions.

Since PC/IX may be too complex for dealers to support, there is an 800 number.

And they do call back! Regularly! On the other hand, they were not able to reproduce any of my problems due to hardware difficulties of their own, and I have yet to get answers to some of my informational questions. But, at least there are live, friendly human beings to talk to.

Since they had just recently released the product, as of this writing, it's not surprising that few problems had as yet shown up, and that they therefore didn't recognize some of the difficulties I had encountered—a bad interaction between PC/IX and the Hercules Graphics board, for instance—and, thus, incorrectly suggested switch settings for the Hayes Smartmodem 1200 as a solution.

Given the likelihood that the product may be complex for their dealers to support, the idea of an 800 number deserves applause. I hope it doesn't get jammed as PC/IX becomes popular, and that they develop more experience with common problems.

Summary

For those seeking a multitasking (and possibly multiuser) operating system on the IBM PC, UNIX is the system of choice. With tens of thousands of installations and hordes of programmers who know and love the system, UNIX is expected to dominate the operating system market in the 1980's.

PC/IX is a strong implementation of UNIX System III, with a few deficiencies (no *vi* or C-shell). The editor is simple and convenient to use, and almost all of the tools familiar to those who have worked on UNIX before are shipped with this version (700-800 files on the distribution disks). The system is slow when performing simultaneous jobs, but is adequately quick on interactive tasks. And the distributor, IBM, seems to have the financial wherewithal to remain in the software business in order to be able to provide support—at least for the near future.

PC/IX is available for $900 at the IBM Product Center in your area.

CIRCLE 322 ON READER SERVICE CARD

Peter Brooks, 525A 6th Ave., Brooklyn, NY 11215

System requirements:
IBM PC or XT with:
1 dual-sided floppy disk
10 MB hard disk
256K RAM
monochrome and/or color monitor

Optional hardware supported:
up to 640K RAM total (512K recommended for multitasking)
8087 math processor
3 additional single- or dual-sided floppy disks
1 additional 10 MB hard disk
2 serial ports
2 parallel ports

Software modules *(all optional except core):*

3.4 MB	core system (required)
1.3 MB	programming subset *(adb, as, cc, lint, lex, yacc...)*
.3 MB	communications *(connect, uucp...)*
.3 MB	source code control system *(sccs)*
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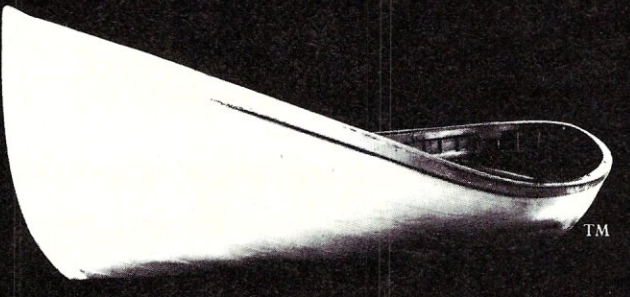

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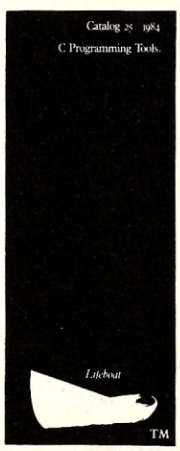

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The UNIX Experience

The first in a series of personal views

by Ronald J. Gombach

What, in fact, *is* the UNIX operating system? To find any reasonable response, we must consider the notion of system. A system is not something 'given' in nature. It is the observer who recognizes interrelated unities as a 'system' and imparts purpose to it. We all see things differently, of course—and therein lies the difficulty in deciding on what is to be considered as 'fact' about any system. Our realm of discourse, here, is the class of unities we call operating systems in general, and UNIX in particular. As a community of observers, we must first agree on the boundaries and purpose of our system before we can agree on what is to be counted as fact. But just reflecting on the difficulties of reaching agreement on boundaries and purposes alone is enough to make even the most ambitious modern-day Don Quixote run for cover. The difficulties of reaching agreement on more detailed topics are even more formidable.

Two decades ago, computer textbooks skirted the philosophy of systems in general and distinguished operating systems only in terms of communicating with peripherals, task management, resource management, and the like. The structure and organization of these unities were tightly knit into the the physical topology of particular hardware architectures. In the finest Aristotelian manner, operating systems were implemented as technological activity, as distinct from theoretical thinking.

Twenty years later, operating systems have evolved beyond mere implementation, and with that evolution, our notion of operating systems has changed, too. Fortunately, along the way, some solid theoretical thinking was combined with the technological activity. What came from Kenneth Thompson and Dennis Ritchie is a distinguishable entity of this contemporary synthesis—UNIX.

Because UNIX was initially developed as an ad hoc tool to help in the solution of a particular class of research problems, and evolved within the topology of a particular class of hardware, there were (and in some versions still are) components that tend to place constraints on the much greater capabilities of today's computers. UNIX was designed as a development environment by and for programmers. As the rate of change in hardware escalates, the need for software engineers to implement op-

erating systems has accompanied it. As UNIX moves out of the laboratories and universities into an array of diverse commercial applications, it acquires new, coexisting purposes.

UNIX is currently a significant part of the daily personal and professional lives of people in media, universities, professional societies, and user groups, as well as most conceivable types of commercial enterprise. As each element in the user base discovers its own view of the nature and purpose of UNIX, it tends to recognize the facts relevant to its own concept of the system.

Why are so many different groups of people so involved with UNIX? Software developers like the philosophy, the portability, and the functionality. The philosophy is that of treating program input and output in a coherent and completely consistent way, whether that output is directed to files or to a peripheral. This implies the existence of logical devices whose interface to the inner system kernel is constant and well defined; only the interface to the physical device is hardware dependent, and therefore specific. It is just that philosophy that makes the system portable across the boundaries of very different computer architectures. This portability protects software development investments. The functionality is established by the large number of powerful software tools that are normally provided as part of the UNIX package and that also work consistently regardless of the hardware being used.

End users like UNIX because the portability protects their investment in applications software in the event that they need to expand to a different or larger machine which may have a different architecture.

Hardware manufacturers like UNIX because much of the system is written in C; thus porting the system from one machine to another, while hardly a trivial task, is largely a matter of creating a compiler for the target machine—and C is a language that allows quite close contact with the hardware. The investment of money and time required for creating a C compiler is minimal compared to what is involved in creating a whole new operating system to match the hardware; in the present competitive state of the market, the saving in time is far more significant than the monetary savings.

Value-added retailers like the system because it is reliable and predictable—thus, applications software written to run under UNIX can be expected to produce identical results, no matter what the hardware may be.

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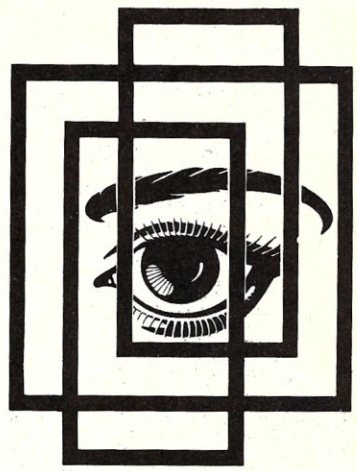

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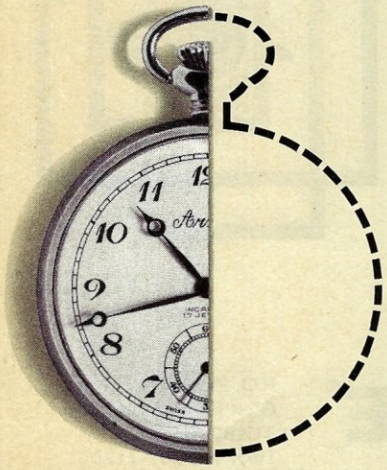

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Enterprise

Continued from page 81

UNIX, a powerful metaphor for the discovery of principles that run, like unifying threads, across interdisciplinary boundaries. An example that comes to mind is a principle of mathematical physics that can be discovered in a view of some works of art. Heisenberg's uncertainty principle states that the more we know about the mass of a moving object, the less certain we can be of its velocity, and vice versa; a similar effect can be seen in some paintings which, viewed from a distance, present a powerful impression of their gestalt. As the viewer approaches, the details become

How Do People Learn UNIX?

Not easily. With hundreds of commands and files, and many dozens of directories to keep them in (and to search for them), the beginner can be easily overwhelmed by the apparent complexities of the operating system. Yet every experienced UNIX user knows that there are only a few rules needed to control the system—rules which are universally applied. It is very much like an erector set, where the building blocks are mostly different but all of them connect together with the same type of joint. Learning this simplicity can be a long and frustrating process.

The cheapest way to approach UNIX is to grab the User's Manual and a terminal and hibernate in a cubicle for three months (remember the daily supply of corn chips and warm beer). This venerable method was dominant in the Dark Ages (1970's), when learning aids were nonexistent and suffering was holy. Since most systems were in universities, there were plenty of hackers around to provide relief from those nagging everyday questions ("What happened to all of my files?"). This is the Brute Force Approach—the novice is forced to discover the power and the subtleties of all the utilities himself.

With the rise of commercial users, the market in UNIX books opened up. Now there are at least a dozen, all purporting to teach beginners. While a tremendous improvement over teaching oneself, the books suffer some severe limitations. For instance, it's very tricky to teach the use of a screen-oriented text editor to beginners using only written materials, and the editor is usually the most productive tool for novices. Books also suffer from the One-Way Communication problem: there's nowhere to go for answers to immediate questions. On the other hand, they're cheap, portable and available at 2 in the morning. The best of the lot seem to be *A Practical Guide to the UNIX System* by Mark Sobell (see p. 18) and *A User's Guide to the UNIX System* by Thomas and Yates (Osborne/McGraw-Hill, 1982).

Beyond the written word, there's the processed word: computer assisted instruction. IBM is coming out with a UNIX teaching program for their PC/IX, and there is the *learn* program which is shipped with many UNIX systems. Instructional videotapes are also available from companies like Interactive Training Systems of Cambridge, MA.

At the professional end of the scale are the industrial seminars. These range from an afternoon lecture on the virtues of UNIX given at a local hotel, to custom seminars taught at the client's site. In the Rolls Royce category, the Instructor Set of New York, a group of professional UNIX and C instructors, will set up a private one-week seminar tailored to the level of a client's employees using the client's own equipment. They give courses on C and UNIX ranging from Introduction all the way to UNIX Internals (how to modify the operating system if you need to). This is probably the fastest way to productivity with UNIX because good teachers will introduce the tools and techniques not easily discoverable by beginners.

The primary factors of budget and speed of learning are the critical factors here. If an individual wants to master UNIX in his spare time, then curling up with a good book and a warm terminal might be best. On the other hand, if a company wants its employees to be productive as soon as possible, it's wise to bring in the gurus.—*Peter Brooks*

For information about UNIX training, or to set up a training session, contact:

The Instructor Set, Inc.
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more and more prominent, to the point where the original impression of the whole is lost.

I myself like UNIX because it's practically impossible for an individual to learn everything about it...so I'm seldom bored! If nothing else, UNIX is a system of enormous variety, unique in the history of computing. It is operating system, enterprise, tool, philosophy, and metaphor. It is available and accessible. And it is the same system—constant as the Pole star—across all user environments, no matter what the viewpoint of the observer.

In the last four years, I have had the opportunity to be associated with an impressive range of systems that operate around, by, because of—and some even in spite of—UNIX. Hardware prices have ranged from a few thousand dollars to several million; the applications have ranged equally widely from the simple utility to the most complex commercial requirements.

Notice that I don't claim that any of these applications was beyond the scope of other operating systems—far from it. All of them could have been run under CP/M on an 8-bit machine (one at a time, of course, and more slowly), or on an IBM 4030. What, then is so special about UNIX?

To find an answer, you will have to undertake your own journey of discovery; and the 'answer' you find will be the product of your own individual perception of UNIX, drawn from the myriad of unities that UNIX presents. But let me mention a few of the landmarks that other people have found useful in constructing a gestalt of the UNIX world.

One vital clue is that UNIX was the first operating system capable of crossing the boundaries set by individual architectures, though it was not originally intended to do this and, in practice, it can give a pretty rough ride to CPU hardware that has not been rigorously tested *[as Ritchie and Thompson point out in their conversation with* Microsystems *elsewhere in this issue—editor]*. By segregating all of the machine-dependent routines in modules that can easily be adapted to suit the hardware, the creators made it possible for the system to cross machine boundaries. This principle of segregation is also a feature used by CP/M, the operating system that helped significantly to make the microcomputer a viable commercial force. Dare we surmise that the proliferation of the micro has not only played a large part in bringing the computer out of the "temple" of its high priests into the common market, but has also stimulated a demand for the only portable operating system that will run on much more powerful machines?

The fact remains that, because UNIX is available on hardware from virtually every manufacturer, in as wide a price range as there are computers, the OEM now has enormous freedom in choosing from a wide range of computers that will satisfy a staggering array of requirements. UNIX allows implementation of software products on a potential range of architectures that could not realistically be even conceived of at the beginning of this decade. And because it is complex and powerful enough to serve as the foundation for highly complex and sophisticated applications, it has forced the community to take a long, hard look at questions of standards, viability, and pragmatics.

What is UNIX? From one viewpoint, it is a unity striving to reproduce a family of similar, though not identical unities. From another perspective, it is a unity seeking to preserve its identity, by self-production. Gone are the days of operating systems limited to resource management. We are, hopefully, heralding the arrival of organizationally viable man/machine interfaces, realized in the structures of constantly improving hardware topologies.

Ron Gombach (Latham Process Corp., 200 Hudson St., NY NY 10013) is designing a UNIX network to run Prolog.

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The C Power Packs from Novum Organum

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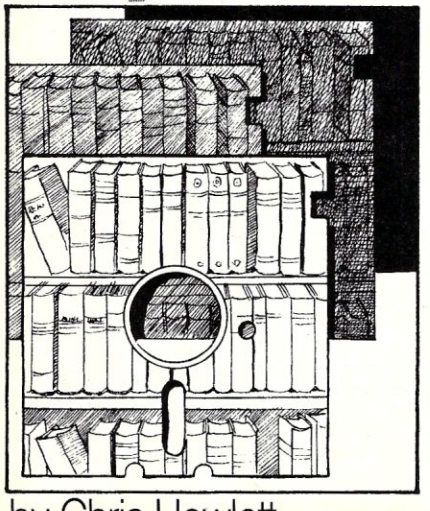

by Chris Howlett

All you IBM PC C programmers gather round—pros and hacks alike! Here is something useful—*very* useful. What we have here is *C Power Packs*, a set of libraries to be used with Lattice C (now also distributed by Microsoft as Microsoft C) on the IBM PC and hardware lookalikes. The libraries have been designed to handle the boring recurring chores associated with the PC hardware and DOS environments—screen management, keyboard handling, indexed record management, controlling communications ports and intelligent modems, accessing DOS system services, and so on. The Microsoft library gives the programmer a handful of functions—just enough to get very simple programs going. Power Packs provides over 600 functions in six libraries, and gives the programmer almost everything he needs to solve real computing problems in sophisticated ways. The programmer can concentrate on using the power of the PC to build applications, without worrying about the largely irrelevant technical details of building C functions to access that power.

A program development environment like this ought to be measured along several dimensions:

1. Reliability: do the functions work properly?
2. Quality of documentation: can you quickly locate functions, and can you quickly determine how to call them?
3. Completeness: do the functions cover all of the basic necessities in the areas they address?
4. Style: are the functions designed in a consistent manner, making it easy to remember both names and calling syntax?

C Power Packs is an outstanding set of libraries on all of the above counts. I have no hesitation in recommending it to any programmer interested in producing more applications code, using more of the PC capabilities, in much less time. Now, for a closer look into Power Packs.

Background

Power Packs were written by Kurt Klinzing, whose software company is called Novum Organum (Arlington, MA). The products are being marketed by Software Horizons, Burlington MA.

Kurt spent 1982 and 1983 programming in C on the IBM PC. The

wide variety of work he did required that he build a large number of functions to execute tasks of a general nature that recurred from application to application. To quote from the introduction to the Power Packs manual set:

> "I found myself in possession of a large amount of code performing a wide variety of tasks. Since most of these tasks were common processes, I decided to make the code available to the C community.
>
> "The tasks were grouped into 'building block' libraries. To create an application, you assemble the blocks. This method of application building allows you to skip over 'reinventing the wheel' and to concentrate on those parts of the application which make your product unique, its user interface and its proprietary algorithms and data.
>
> "...Sections A through K of the Building Blocks...include access to all system services, mathematics functions, record and key handling, extensive date/time functions and communications. Additional Building Blocks will follow. These include: Word processing, Lexical Analysis, Pattern Matching, Text Dictionaries, Database Dictionary, Sorting, Integer Functions and Graphics."

The libraries

C Power Packs version 5.00 supports the Lattice(/Microsoft) C compiler under DOS 2.00. Software Horizons states that "other compilers will be supported in the near future."

The contents of the Power Packs are listed in Table 1. Although space does not permit a detailed review of each of these libraries, we will touch on the highlights later. First, some comments about documentation and style.

Documentation

The documentation is very good. It is complete, well indexed, supported by narrative and examples, and seems to be close to error-free.

The manuals for the six "Packs" are page numbered as sections of a single large manual. The full document set is over 2 ½" thick, and requires a binder of uncommon strength to hold it together. However, things are easy to find. There is a master table of contents, grouped by section within "Pack" manual, and there is a master alphabetical index by function name. Each "Pack" manual also has its own table of contents and index.

Examples are numerous and effectively chosen. For example, the section on string handling functions in Pack 1 contains 53 functions. Their use is illustrated by over 30 examples. Typically, related functions are grouped, and a small set of examples is provided for the group.

Functions are consistently documented in the normal terse fashion: name (with descriptive phrase), argument types, synopsis and description. Where several functions represent small variations on the same theme, they are grouped and share descriptions. This helps to control the sheer volume of documentation required.

"I found myself in possession of a large amount of code performing a wide variety of tasks...."

Each section of each manual has some introductory comments, and some sections have additional narrative material. Notable among these are the introduction and appendix to Pack 2 (database). Included are 72 pages of information on such things as how B*-trees work, how records are identified and stored in the record management system, and how the buffering strategy works.

Finally, the documentation appears to be almost error-free. I have used around 200 of these functions over the past several months, and I've found only three errors in the documentation. In each case they may have been typos, but they were significant (for example, a missing '*' on a pointer argument type declaration).

However, in each case, once it was clear that the function did not work as documented, it was pretty obvious what the documentation error had to be. Certainly no phone calls to the author were necessary on these accounts. In fact, no phone calls to the author were ever necessary throughout the review period—the documentation answered all questions.

Style

The Power Pack functions are designed according to a particular paradigm, are named according to certain conventions, and are written in a thoughtful, disciplined style. The design paradigm is Smalltalk 'object-oriented programming.' What this means in practice is extensive use of abstract data types (e.g., 'text window,' 'comm port'), which have 'instances' identified by 'handles,' with accompanying functions that return attributes and cause actions ('methods'). The author's only comments on this pervasive design theme appear in a footnote in the Pack 3 manual. It might be better to move this interesting discussion to the Power Packs introduction, and expand it somewhat.

Functions are named according to the following convention:

```
<Fn group> <Verb> <Operand>
```

For example, FlSetDta is a function in the file operations group (Pack 1) that carries out the action 'Set' on the DOS disk transfer address. Similarly, CrtClr is a function in the screen handling (Pack 1) group that clears the screen (Clr). Most functions in the file group start with Fl, and all functions in the screen handling group start with Crt. The naming standards are fairly closely followed, and there is enough consistency across the Power Packs that the user looking for a rarely used function can normally guess the first few characters of the name, and then quickly locate it through the manual index.

The Novum Organum programming style is visible in the examples and in the source code supplied with Pack 1. The style is characterized by very small single-purpose functions, identifier naming conventions that promote information-revealing names, and a rigid coding format (one statement per line, indenting rules, etc.). The main benefit of this style to the Power Packs user is that the examples are very easy to follow because of the consistent coding formats and the information-revealing entity naming. Also, the Novum style is a good model for beginners trying to learn good C programming practices.

The remainder of this review will discuss highlights of the individual Power Pack packages.

Pack 1—Building Blocks I

This pack contains string functions, file management functions, system utility functions, screen functions and keyboard functions.

The string functions contain a large number of expected operations such as insert, compare, reverse, center. One particularly useful function is CpyStr,

Power Packs

Continued from page 85

which concatenates a variable number of string arguments. Another enhancement is StrFmt, which operates like *sprintf*, except that the fill character for integer fields can be redefined by an extension to the '%' *printf* control argument syntax. This can be useful, for example, for filling currency fields with '$' rather than blanks.

The file management functions are routine and predictable, but, of course, essential. They provide access to all simple file operations implicit in DOS 2.0, including pathname support, directory changes, makes and removes, and including direct access for fixed-length record files (read record N, write record N). It should be noted that the ability to open files with nontrivial DOS 2.0 pathnames is now part of Lattice C 2.0, but was not included in prior releases of the Lattice compiler.

The system utilities include some very powerful functions. SyExec will cause another program to be executed under the calling program. SyDos is a SyExec of a secondary command processor, and allows a program to execute any DOS command (e.g. COPY, DIR) directly. But the cutest by far are SyEnter and SyLeave. These functions allow simpler error handling logic by providing for error exit trapping. An example of how they might be used is shown in Figure 1. (I hate to say this in an article for C afficionados, but it's just a little bit like Basic's ON ERR GOTO).

The screen functions are quite exhaustive. They allow for color control of the color graphics adapter, cursor positioning, scrolling, clearing, etc. They provide geometric primitives such as dot, arc, circle, pieslice, and rectangle for graphics adaptors. My favorite in the 'Crt' repertoire is CrtFmt, which is a *printf* enhancement that extends the K&R control argument syntax to allow embedding attributes such as highlight, reverse video, underline and color change within the control string. For example:

```
CrtFmt("Hello ^R%s^R\n\r",
    str);
```

prints the string variable str in reverse video after "Hello."

One very significant feature of the screen functions is their speed. Novum Organum has optimized these functions through effective direct use of the video BIOS, and by improving commonly used string handling functions. For example, the Lattice *strlen* function has been replaced with a much faster one implemented with the 8088 *rep scasb* instructions. CrtFmt does direct calls to video BIOS, while the Lattice equivalent, *printf*, loops on *putc*, which in turn goes through DOS services. Keep in mind that the Novum objective is high PC performance, not broad portability.

The archiver is well suited to program development.

The keyboard functions are designed to return two variables: a type and a character. The way in which this is done makes for very readable programs. The type indicates such things as ALT and CTL, and the character is the corresponding keyboard character. This is a very sensible way of hiding the curious way in which the keyboard BIOS encodes 'extended ASCII codes.' The keyboard functions provide access to shift states, and support both redirection from files and audit logging to files. Finally, the keyboard functions support entry of typed fields on the screen and multiple windows (Pack 4).

Pack 2—Database Building Blocks

This pack is simple, elegant and powerful. It includes four integrated components: a variable-length record management system, a 'virtual memory' object management system, a B*-tree indexing system, and a list management system.

The basic record management system supports variable-length records up to 2000 bytes in length. Longer records can be created and retrieved by using an extension technique for which primitives are provided. Records are stored physically in 'pages' (2K), in which space lost to fragmentation is reclaimed as necessary. Record IDs are 32-bit unsigned numbers developed by concatenating the page number with the cell number of an array of offsets within the page, paralleling hardware virtual memory architectures. This technique, called 'unpinned data storage,' allows for physical relocation of records without the necessity of updating pointers to the record—the ID, or 'handle', is unaffected. The benefit is in much more efficient updating. Memory allocated for buffers is specified at database open time, and the scheme used is a variation of LRU.

The virtual memory system is an in-memory temporary database with provision for spilling to disk. In practice it is useful for organizing transient objects; for example, names of files picked from disk directories for subsequent batch (group) processing (e.g., a remote transfer). Another example, put forward by the library author, is the storage of components of complex computer graphics constructs.

The B*-tree indexing allows four types of keys: character strings (up to 128 bytes), byte strings (up to 128 bytes), unsigneds, and longs. Up to 50 indices may be active at once, and duplicate keys are allowed.

Lists are ordered sets of 32-bit entities, normally record handles. They are stored as objects in virtual memory and are therefore transient. Lists can have

Table 1. Individual Power Pack packages

Pack 1	*(Building Blocks I)*. Provides elaborate string handling, DOS file system access, screen handling (including graphics), keyboard handling and miscellaneous system utility functions. Approximately 275 functions, 250 pages of documentation.
Pack 2	*(Database Building Blocks)*. Variable-length record management, virtual memory object management, B*-tree indexing, integrated list management. Approximately 80 functions, 175 pages of documentation.
Pack 3	*(Communications)*. Serial port interrupt handling, Smartmodem control functions, file transfer, and terminal program building blocks ('chat controller'). Approximately 135 functions, 85 pages of documentation.
Pack 4	*(Building Blocks II)*. Field input, date/time manipulation, text windows, data compression. Approximately 110 functions, 105 pages of documentation.
Pack 5	*(Mathematics)*. Trig functions, logs, powers, random numbers. Approximately 30 functions, 30 pages of documentation.
Pack 6	*(Utilities I)*. Archiving utility. 5 pages of documentation.

elements that point to other lists and are therefore recursive. Lists are usually used to organize objects in virtual memory. The author cites the example of elements of a picture display. The example of maintaining temporary lists of files for batch processing is also instructive. Twenty-one functions are provided for list processing.

Pack 3—Communications Building Blocks

Here is another strong, well-thought-through pack. There are four major building blocks in this system: the chat controller, interrupt-driven port functions, modem functions, and file transfer functions.

The chat controller is an interesting mechanism. Those who have written more than one terminal program will have recognized that there is a common underlying engine with various sorts of desirable settings. The engine polls the keyboard and the serial line buffer(s); it normally writes line input to the screen, and keyboard input to the line. However, certain keyboard sequences must be interpreted as terminal control characters. In addition, it is useful to be able to set the engine to translate to upper case, insert line feeds after carriage returns, save incoming data in a log (trace) file, and so on. Finally, the engine is most powerful if it offers 'user exits' at critical points, such as 'character extracted from line buffer.' The chat controller is an implementation of such an engine. There are 22 functions available to set chat attributes such as those mentioned above. User exits are available for help processing, display of incoming characters, display of outgoing characters, command processing, file reception (i.e., file transfer protocol handling) and file transmission.

The interrupt-driven port functions provide for intialization, communications parameter setting, and the expected suite of buffered I/O functions—in, input-ready, out, flush. These functions are not coded by a chat application—the chat engine handles them.

Modem functions are specific to the Hayes Smartmodem, and provide access to most of that device's capabilities: initialize, escape to command mode, send a command to the modem, dial, drop line, answer, etc.

Transfer functions include such high-level workhorses as XmitMdm7—transmit a file in Modem/X-modem protocol. The basic protocol-handling functions (seven of them) are supported by a variety of utility functions for accumulating statistics, such as block counts and error counts, about the progress of the transfer.

Finally, there are a number of miscellaneous utility functions relating to bulletin board downloading, XON/XOFF flow control, packet checksumming, and so on.

The tools are here to build a wide variety of communications applications. There is extensive documentation (85 pages), but in my view there should be more. This a complex subject, and ought to be supported by at least some narrative on protocols, in the same way in which the database pack manual goes into useful detail on the physical implementation of the record management and indexing systems. However, for those who know something about the protocols, or who don't care, this pack opens the way to very rapid development of communications programs.

The screen functions in Pack 4 are exhaustive.

Figure 1. SyEnter()/SyLeave()
Example taken from the Pack 1 manual

```
A()
{
     if   (SyEnter(&B, arg) != 0)
     (perform error handling)
}

B(arg)
int  arg;
{
     C();
     return(0);      /* note the B() must now return NOERR */
}

C()
{
     if   (error)
          SyLeave(errorcode);      /* back to A() */
}
```

"The use of Syerr()/SyLeave() greatly simplifies the middle-level functions of a processing branch, since they no longer need to check for errors in the lower level modules. The complexity of the upper level and lower level routines is the same as without SyEnter()/SyLeave().

"For example, if a program is started from main() with a SyEnter() for the 'real' main, and if no further SyEnters are done, any internal errors detected by the Power Packs will be returned. e.g., if the Pack 1 memory allocation functions GiveMe() and Takeit() are used, out-of-memory conditions are signalled by a SyLeave(-4). Although the Power Packs use SyLeave for unrecoverable errors, it is not necessary to do SyEnters. In that case the SyLeaves result in program termination with cryptic error messages.

"Finally, SyEnters may be 'stacked.' Up to 15 may be active at any point in time."

Pack 4—Building Blocks II

This pack provides typed field input; for example: 'Enter double floating point from console,' 'Enter hex from console.' A nice touch is 'Enter choice,' which presents a menu of cursor or first-character selectable labels, with help text appearing underneath as selections change—in the manner popularized by Lotus and Multiplan.

If you have ever wanted to print the date and time, has Kurt got something for you! 40 functions relating to presentation and storage of dates and times. An example is shown in Figure 2. Almost every conceivable variation is supported, including the ability to supply user strings for month and day tables (e.g., to display the date and time in another language). There is no facility for printing years in Roman numerals, but not many will consider that a liability.

The best thing in this pack may well be the text window support. Text windows are objects (with handles) which allow the programmer to create scrollable independent regions on the screen, each with its own attributes,

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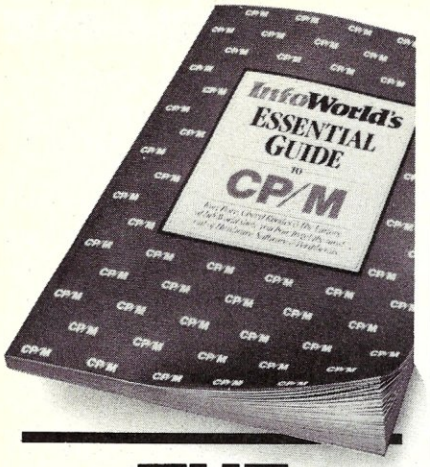

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Power Packs

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cursor location, etc. Whoa! This is not Lisa/3270-PC/MS Windows. These windows are very simple. They extend the width of the screen, they don't overlap, and they don't have memories, so they can't be hidden and restored with contents intact. However, they can be very useful, and they are extremely easy to implement. Kurt uses them in his archiving utility for scrolling lists within a static 'help' border. I have used them in several terminal emulators, typically to hold dynamic soft button displays and to scroll asynchronous system messages along with the terminal window. Creating and using a text window proceeds like this:

1. Create the window: IstTWnd
   You supply size, position, and title (if you want one).
2. Set any special attributes: TWAttr
   Such things as high intensity, word wrap.
3. Make the window visible: TWShow
4. Write to the text window—e.g., TWFmt works like CrtFmt within the window
5. When you're finished, release it: RlsTWnd

All of the functions after IstTWnd take the window handle and possible other parameters. Here, I have a small complaint. It is easy for one (at least, *this* one) to forget the handle parameter. The results are always unpredictable, sometimes beautiful, and often lead quickly to the need to power-on reset the PC. It would be useful if more validity checking of 'objects' (handles) were done throughout the Power Pack libraries.

Pack 5—Mathematics

This pack is a disappointment. It is simply not up to the first four in terms of richness of content. In my view, functions of this sort are of interest in engineering and scientific applications, and this audience probably needs a much wider variety of tools. This pack should either be significantly expanded, or quietly dissolved and merged into Pack 1 or Pack 4. On the other hand, to be fair, this pack is as good a value (in a price/performance sense) as some other C libraries on the market. However, it is not up to the standard set by its companions in the Power Pack club.

It does sines, cosines, tangents and their inverses. It operates in degrees or radians. It does logarithms, natural and unnatural, and exponentials. It does means and standard deviations.

This is the only pack I haven't used extensively over the past several months. To be honest, I haven't used it at all—I simply never needed the functions. Come to think of it, maybe I ought to have abstained from judging it.

Pack 6—Utilities I

This pack is not a library—it is a group of three programs: an archiver, a deleter that will traverse subdirectories, and a directory displayer that will traverse subdirectories.

The archiving program is an online archiver, very good for saving large numbers of small files. As the author says, "This rids your directory system of much clutter, but still allows you to have the files on-line."

Files in an archive maintain their seperate identities. The names of all of the files in an archive can be listed, individual files (or all files) can be extracted as standalone disk files, displayed on the screen, or printed. I/O redirection of input is supported.

The archiver uses the DOS environment to determine the default pathname for archive files. This allows archiving from anywhere on a hard disk as long as the archive program is in the current program search path, without the necessity of remembering and typing the archive directory. Also, the archive default directory can be changed quickly with a SET command.

The archiver is a slick program that seems to be particularly well suited to a program development environment. It is very good at organizing large numbers of small source modules—which is not surprising, since the need for managing a large number of files is apparently what gave birth to it.

Figure 2. Date and time example

```
Thecommand,
     CrtFmt("%s, %s\n\r",
          UtFmtJul(s, "^W the ^dnd of ^M", SyRetJul(),
          UtFmtClp(t, "^H:^M:^S ^P", SyRetClp())
          );
```

would print (as I write this)

```
Thursday the 2nd of August, 3:49:03 AM
```

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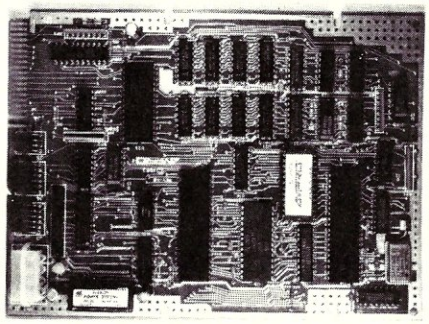

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Power Packs

Continued from page 88

The second program, called *wipe*, is a deleter. Given a file pattern and a directory to start in, it will delete all matching files in the associated subtree; i.e., in that directory, and in any subdirectory reachable by descent from that directory. Clearly a useful thing for a hard disk riddled with .bak and .lst files.

The third program, *scan*, operates like *wipe*, but simply displays directory information for matching files in the subtree. A good thing to use before wiping.

Conclusion

C Power Packs is on the whole an outstanding value. If you are heavily into arctangents, I'd even remove the qualifier. These packs together constitute a development environment which should give most independent PC programmers (using Lattice/Microsoft C) the ability to quickly begin producing code at a rate far exceeding what they are used to. Individuals will probably have been forced to develop variants of some of these tools themselves, but it is unlikely that they will have more than a small fraction of what is available, working and documented here. Even larger software houses, with substantial investments in their own proprietary libraries, may find useful goodies in some of these packs. For this latter market, Software Horizons might be advised to consider a more flexible source licensing arrangement, since component sources are likely to be a precondition for those building applications for broad distribution and support. Currently only Pack 1 comes with source.

A final gratuitous observation for Software Horizons and Novum Organum: I really did prefer the original name—"C Building Blocks." It doesn't have the Duracell connotation.

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Chris Howlett is President of Co-Triple Computer Systems, 570 Hood Rd. #15, Markham, ON Canada L3R 4G7. His company develops C applications for PCs, specializing in data communications. Though he holds a doctorate in mathematics, he admits he has only rarely felt the temptation to compute an arctangent.

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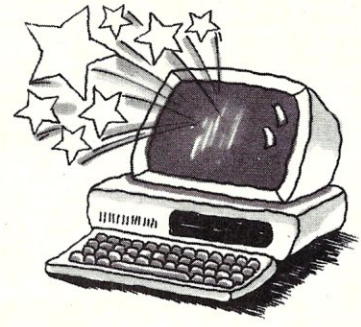

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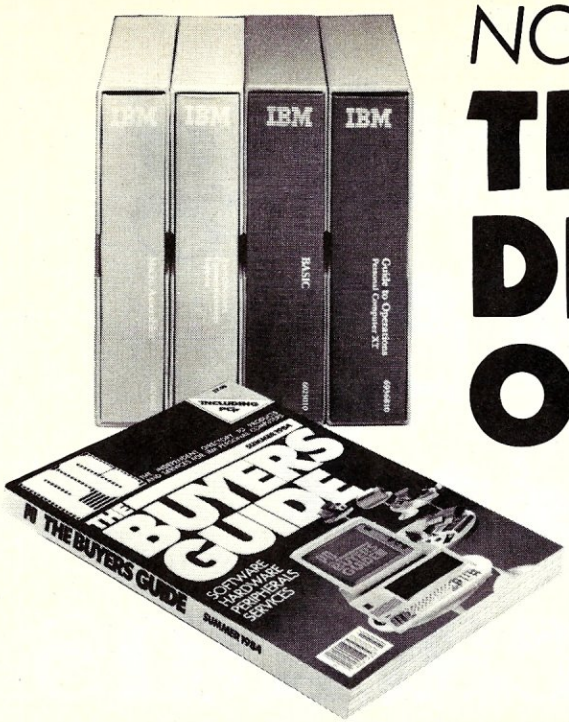

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Implementing X.25 Communications Protocol

Part 2: Implementation with the Intel 8273 chip

by Eric L. Beser

In Part 1 of this series (*Microsystems*, June 1984, p. 46) I outlined concepts that were necessary to understand layered architecture, reviewed basic finite state automata theory, and outlined the implementation details of CCITT Specification X.25. If you recall, I noted the importance of implementing the data link layer as a finite state machine in order to keep track of the numerous states and transition events that occur. In this issue I will describe how to build this protocol machine, and I will include a library module with procedures and functions to drive it.

I also noted, in Part 1, that you need specialized hardware to implement X.25 communications because of the zero-bit insertion/deletion at every fifth consecutive one-bit. The remaining two parts will describe the hardware details and the drivers needed to implement the physical layer. The specialized hardware that I will cover is the Intel 8273 HDLC device, the 8274 Multiple Protocol Serial Converter (Intel's version of the Z80-SIO), and Western Digital's 2511 LSI chip. I will present physical-level drivers for the 8273 and 8274. Since the 2511 chip has microcoded the level 2 and level 1 software within the chip, as you will see, all that is needed to implement X.25 protocol with this device is to provide buffer management.

Implementing a protocol state machine

Due to the nature of layered architecture, all of the procedures in our protocol machine must deal strictly with the datalink layer. This requirement translates into two simple design rules that we must follow to maintain layer transparency:

1. There must be only one interface going into the machine, and only one interface going out of the machine. These are the only two connections that the layers above and below may see.

2. Each layer must provide only one function. In our case, the level 2 function is to provide for an orderly transfer of frames between links, including what to do when order breaks down.

Implementation language. I chose Pascal as the implementation language because of its portability. Pascal MT-86 (a trademark of Digital Research, Inc.) was chosen because it generated relocatable hex code that may be burned into a ROM. The only nonportable Pascal functions used were "shiftleft," "shiftright," "input," and "output," which are usually implemented in other

versions of Pascal, or may be written easily in machine code. Some procedures in the source listing are called by the level 2 module, but are listed as external. These procedures and functions are not relevant to level 2 but are necessary in a multitasking environment. Since there are enough references with source listings of multitasking kernels, I did not include the operating system as part of the listings.

Data structures. To begin learning how to build the level 2 machine, it is necessary to look at the essential data structures and how they are manipulated. The primary function of the datalink layer is to maintain an orderly transfer of frames between layers. The most important data structure is the frame; the manipulation of this frame is handled by buffer management. Second, because the datalink layer is built as a finite state machine, we need some finite states and events to work with. The next most important data structure then is this state-event table. All of the procedures in the level 2 machine manipulate one or the other structure in some fashion.

Buffer management

In this implementation of the protocol machine, there is a contiguous block of memory organized as a pool. This pool is managed by the Frame_Block data structure organized as a linked list. This structure is declared as shown in Listing 1.

Since the pool is organized as a linked list, there are forward and backward pointers (fwd, bwd); an information enumerated type for use in error management or garbage collection; a message length field that tells us something about the size of the data in the

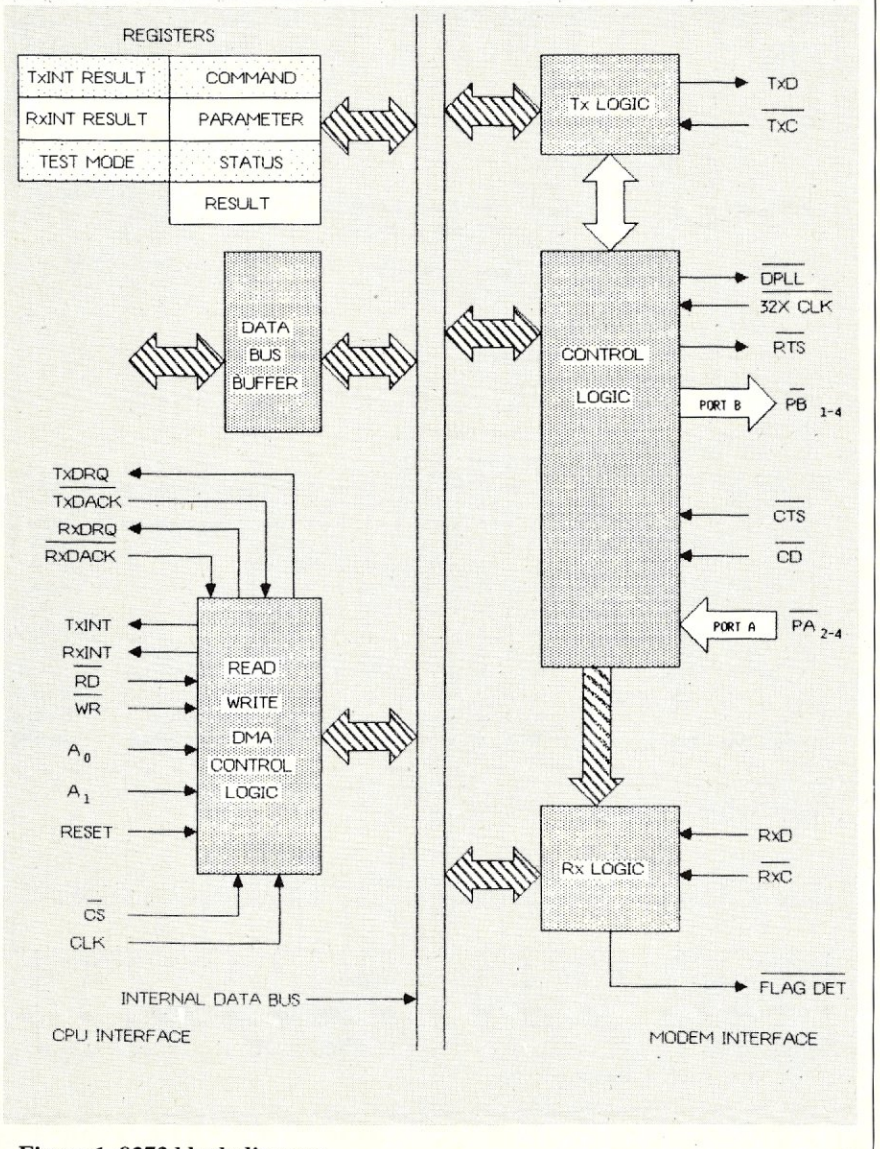

Figure 1. 8273 block diagram.

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X.25 PROTOCOL

Continued from page 93

frame; and the address, control, and data fields of the frame to be sent in or out. The actual size of the data block varies with memory usage and with the quality of the link.

Because the datalink is a full-duplex operation (data going in and out simultaneously), there are two queues, one for incoming data and one for outgoing data. There is an additional queue for maintaining a history of frames sent but not acknowledged. This queue is used for handling timeouts and the *rej* supervisory frame. Whatever memory is left in the frame block is used for transmission and reception of supervisory frames.

The queue data structure is organized as shown in Listing 2. The head and tail pointers index into the frame array; it is up to the buffer management routines in the operating system to make sure frame boundaries never cross. In our implementation, one routine manages all the queues. The level 2 functions and procedures do not handle the nuts and bolts of buffer management. Level 2 blindly accepts the fact that queues are managed somewhere . . . somehow.

Finite state machine

The state-event table can be called the brains of the organization. It is a two-dimensional database indexed by event and by the current state of the machine. This table consists of a numeric

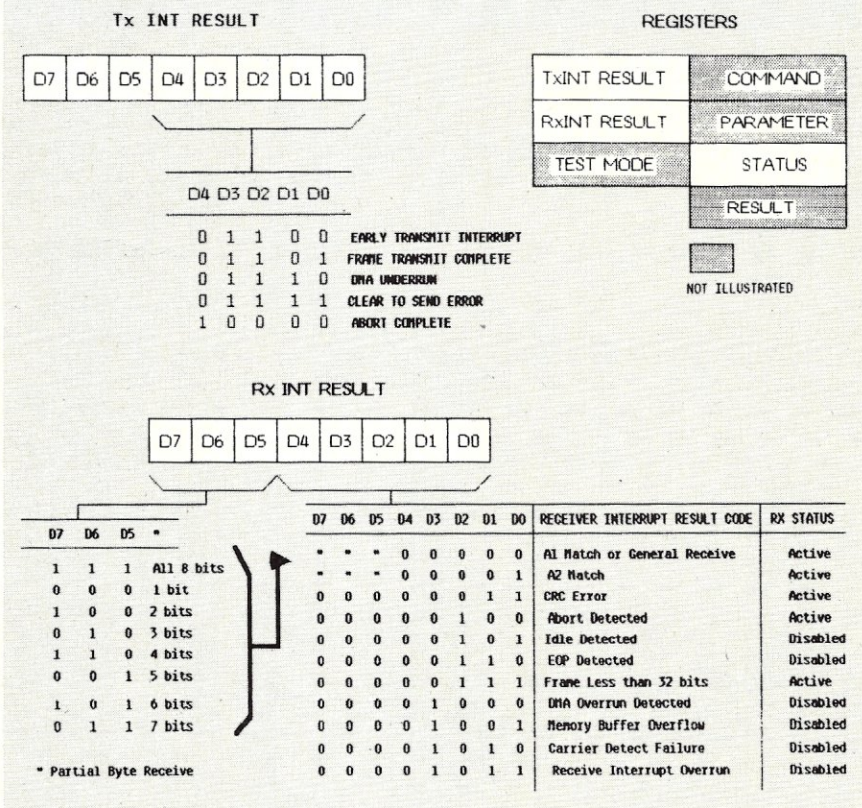
Tx INT RESULT
D7 D6 D5 D4 D3 D2 D1 D0
D4 D3 D2 D1 D0
0 1 1 0 0 EARLY TRANSMIT INTERRUPT
0 1 1 0 1 FRAME TRANSMIT COMPLETE
0 1 1 1 0 DMA UNDERRUN
0 1 1 1 1 CLEAR TO SEND ERROR
1 0 0 0 0 ABORT COMPLETE
REGISTERS
TxINT RESULT
RxINT RESULT
TEST MODE
COMMAND
PARAMETER
STATUS
RESULT
NOT ILLUSTRATED
Rx INT RESULT
D7 D6 D5 D4 D3 D2 D1 D0
D7 D6 D5 *
1 1 1 All 8 bits
0 0 0 1 bit
1 0 0 2 bits
0 1 0 3 bits
1 1 0 4 bits
0 0 1 5 bits
1 0 1 6 bits
0 1 1 7 bits
* Partial Byte Receive
D7 D6 D5 D4 D3 D2 D1 D0 RECEIVER INTERRUPT RESULT CODE RX STATUS
* * * 0 0 0 0 0 A1 Match or General Receive Active
* * * 0 0 0 0 1 A2 Match Active
0 0 0 0 0 0 1 1 CRC Error Active
0 0 0 0 0 1 0 0 Abort Detected Active
0 0 0 0 0 1 0 1 Idle Detected Disabled
0 0 0 0 0 1 1 0 EOP Detected Disabled
0 0 0 0 0 1 1 1 Frame Less than 32 bits Active
0 0 0 0 1 0 0 0 DMA Overrun Detected Disabled
0 0 0 0 1 0 0 1 Memory Buffer Overflow Disabled
0 0 0 0 1 0 1 0 Carrier Detect Failure Disabled
0 0 0 0 1 0 1 1 Receive Interrupt Overrun Disabled

Figure 2. 8273 registers.

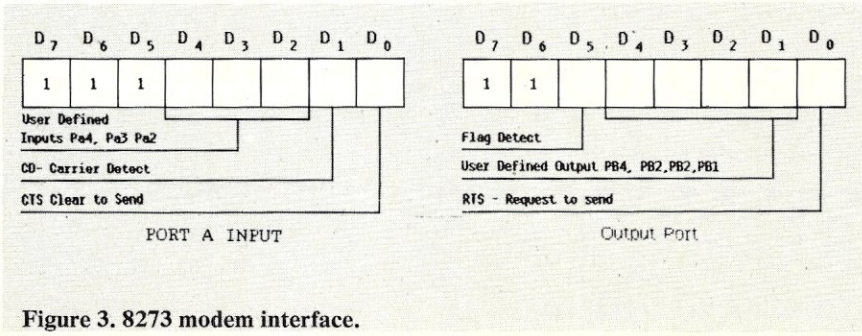

Figure 3. 8273 modem interface.

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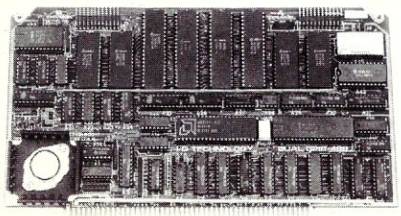

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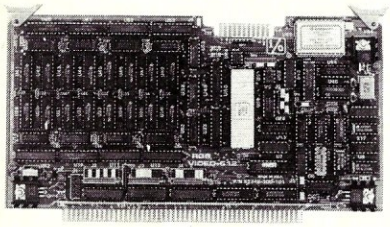

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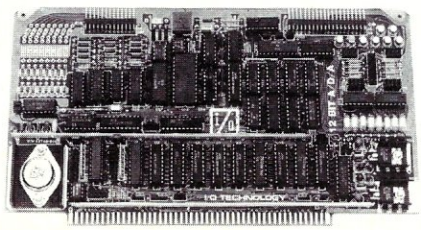

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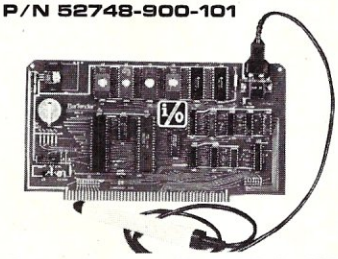

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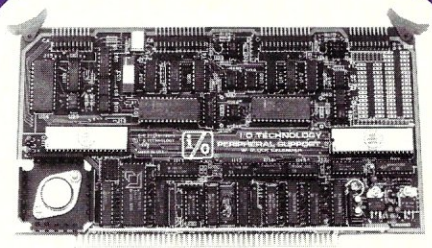

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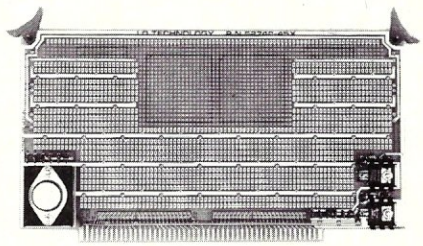

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X.25 PROTOCOL

Continued from page 94

code called "action," which is used to vector into a rather large case statement. The PDL for this state machine is described in Listing 1 of Part 3.

The listing for the level 2 module has been submitted to the SIG/M library. Two procedures, Decode and Finite_State_Machine, comprise the implementation code of the above PDL. *Decode* takes apart the control field of the frame and assigns a value to event, which is used to index into the state-event table. *Finite_State_Machine* is the procedure that manipulates the state table and maintains control over the other index, "state." This variable may or may not change, but it accurately reflects the current state of the machine. The operating system may also feed events to the machine by changing the event index (i.e., T1 Timeout).

The implementation details of managing the various events have been left as an exercise, since they are not really important for understanding level 2 functioning. (Hint: I recommend a FIFO event queue to maintain an orderly transition of events).

The other procedures in the level 2 module manipulate the frame in some fashion or respond to a given event based on the X.25 specification. Next, let's consider the hardware for the X.25 specification.

8273 HDLC protocol controller

The 8273 is a protocol controller chip that has the specialized features needed for X.25 level 1 implementation. In addition, it has a frame-level command structure that is really quite easy to use. This command structure is due to the dual-processor architecture unique to this chip. The block diagram of the 8273 is shown in Figure 1, and is divided into two parts: a CPU interface and a modem interface.

CPU interface. To me, one of the most important criteria in hardware choices is the ease with which components may be connected together to make a functioning system. The 8273 is no exception, and requires very little effort to hook it up to a DMA controller and CPU. Intel publishes *The Peripheral Design Handbook*, in which there is a comprehensive applications guide with software and hardware examples. It is not my intention to reproduce all of the application notes; but the highlights I give should be sufficient to get the chip operating.

A key feature of the CPU interface is the command structure.

One of the key features of the CPU interface is the command structure. Having received and executed a command, the 8273 returns the results in

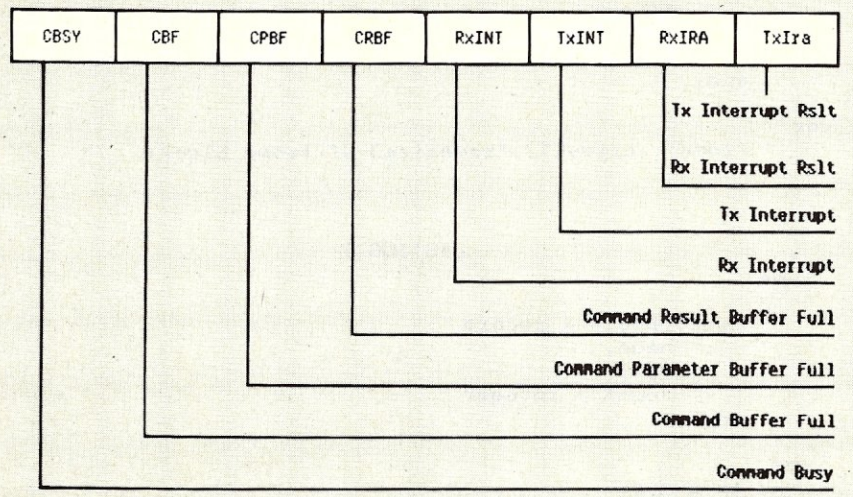

Figure 4. 8273 handshake status registers.

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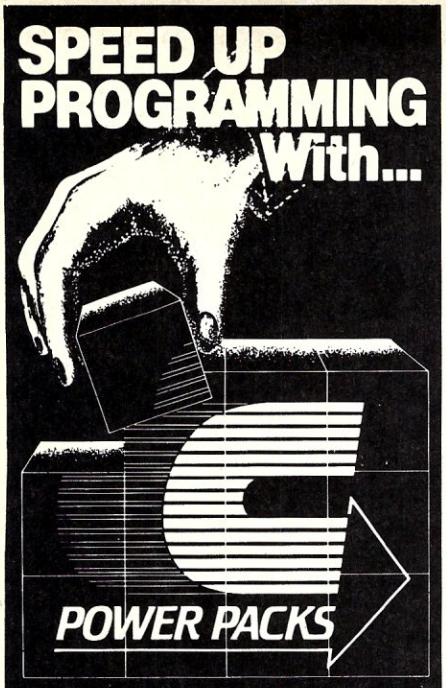

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X.25 PROTOCOL

Continued from page 97

one of the seven registers. Figure 2 describes the registers and the meaning of each bit.

In addition to its command structure, the 8273 supports interrupt lines for both the transmit and receive sides; these indicate that the transmitter has completed a frame, needs another byte to transmit (in a non-DMA environment), has received a frame, or has another byte to store in a buffer (again, in a non-DMA environment). The DMA control lines allow this device to be used in a full-duplex manner. In a DMA environment, the 8273 handles all the requests and block length counting. All that is necessary to do is to provide the DMA chip with the address of the information field or buffer where the information field will be placed.

To use DMA or not is up to the designer. The 8273 chip will operate in an all-interrupt environment; however, if speed and data bandwidth are needed, then DMA is a must. Remember, the CPU must take over when DMA is not provided, and this slows down processing on a real-time basis. At modem speeds of 1200 baud the software overhead is insignificant, but at 19,200 baud or more the CPU may not be able to keep up.

Modem interface. This part of the 8273 provides two services: modem control and serial data timing. The modem control block provides both EIA-compatible control lines (Data Terminal Ready, Clear To Send, etc.) and a register to reflect the state of all the modem control lines. Figure 3 illustrates these registers and what the various bits indicate. If the *CTS goes inactive while a frame is being transmitted, the frame is aborted and the CPU interrupted; and the interrupt results show that the rea-

The datalink layer is built as a finite state machine.

LISTING 1

```
const
     datalength = 140;  {varies with quality of link}
     framesize = 30;    {varies with size of memory}

type
     frame_ptr = integer;

     frame_block = record
          fwd,
          bwd : frame_ptr;
          info : (good_xmit,bad_xmit,aborted_xmit);
          msg_len : integer;
          addr,
          cntl : byte;
          data_block : array [0..datalength] of byte
     end;

var
     frame : array[1..framesize] of frame_block;
```

LISTING 2

```
type

     queue_block = record
          head,
          tail,
          count : integer
     end;

var
     tx_queue,
     rx_queue,
     ack_pending : queue_block;
```

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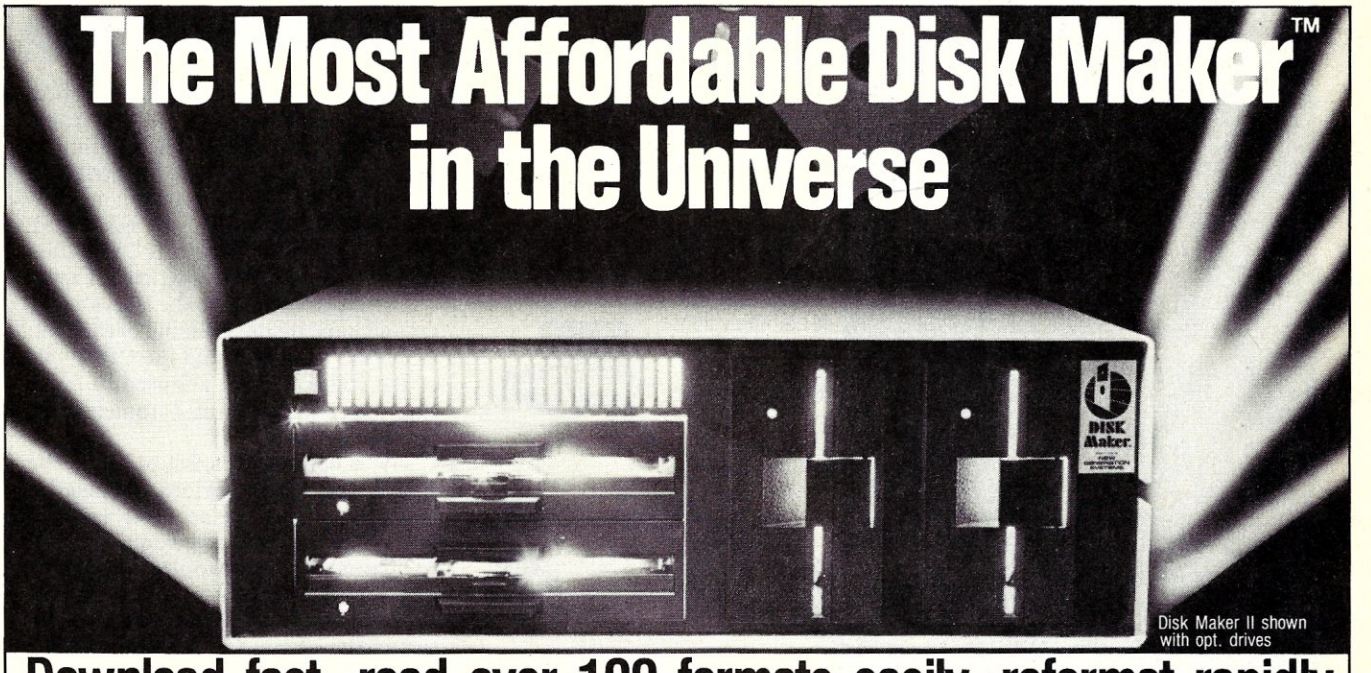

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X.25 PROTOCOL

Continued from page 98

son was a *CTS failure. The *CD line works in similar fashion. The engineer has complete control over the outside environment by handling these exceptions.

To provide serial data timing, the data is synchronized by the transmitter and receiver clocks. Usually these clocks are provided by synchronous modems, but the 8273 has internal phase-lock loop (PLL) circuitry to allow the use of low-cost asynchronous modems. To use this PLL, a clock that is 32 times the data rate must be applied to the *32xCLK pin.

This clock provides the interval at which the PLL samples the incoming data, and is used, along with the received data, to provide an output pulse at the *PLLout pin. This pulse is positioned at the nominal center of the received data bit cell and may be used by RxC and/or TxC inputs to supply the data timing. When the receiver goes idle after 15 one's, PLL pulses are generated at 32-pulse intervals of the 32xCLK. This feature allows the PLL pulses to be used as a transmitter or receiver clock.

To ensure PLL lock, Intel recommends the use of NRZI data encoding of the data. This ensures that, within a frame, data transitions occur within five bit times (zero-bit insertion). Intel also recommends the use of preframe SYNC characters to make sure that the PLL is at nominal center in time for the opening flag. The 8273 has a command for this mode that supplies the necessary SYNC character. There is an additional feature in using this method of encoding. With phase encoding of data, and through the use of the internal PLL, data rates of 9600 baud may be fed through a 1200-baud modem and be received, thus maximizing the transfer rate.

Programming the 8273

Because of the internal processor architecture of the 8273, the software drivers take on the form of interprocessor communication, in that they perform the handshaking involved through the use of a status register. Additionally, software interfacing takes place in three phases: command, execution, and result.

The interrupt flag stays high until all the results are read.

Command phase. The command phase of the 8273 is entered by writing a command into the command register. The procedures write_command and write_parameter in Listing 2 illustrate how this information is written. Figure 4 illustrates the handshake status register and indicate the meaning of each bit. Note that the CBSY and the CPBF bits of the status register are used to make sure the commands and parameters are not overwritten.

If a command is issued while the CBSY bit is 1, the previous command is lost. Since both the receiver and the transmitter use the same command register, it is important to use CBSY as a semaphore to prevent the receiving process and transmitting process from entering the command sequence at the same time.

Execution phase. During this phase, the operation specified by the command written in the command phase is carried out. If DMA is used, there is no CPU involvement. However, if the 8273 is interrupt-driven without DMA, the appropriate interrupt line is raised, and the interrupt routine must

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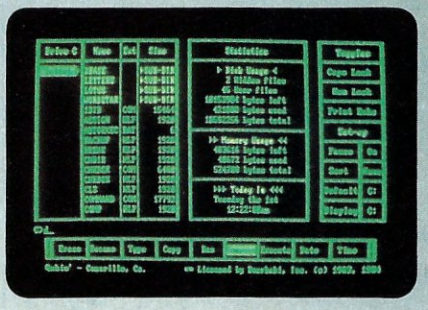

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determine whether or not the interrupt signals the end of the execution phase or is a data transfer request. The status register provides the clue as to why the interrupt took place. If the TxIRA (transmit interrupt result available) or RxIRA (receive interrupt result available) bit is set, the execution phase has been terminated and the result register must be read to determine the success of the operation. If the bit is 0, the interrupt was for a data request.

Result phase software. During this phase, the 8273 notifies the CPU that the operation was carried out with success or failure. The results are provided in the result register. The driver for the result phase must check to see if either TxIRA or RxIRA is set, then read the results into some buffer. The interrupt flag remains high until all the results are read, so that it may be used as a loop variable to make sure we read all the results. Otherwise, the interrupt bit (and line) will remain high and we will miss new interrupts. Procedures Tx_8273 and Rx_8273 are the interrupt drivers operating the 8273 during this phase.

Module L1_8273

L1_8273 is the library of procedures needed for implementing level 1 of the X.25 protocol. As in Listing 1, only the procedures necessary for level 1 operation are listed; everything else is referenced as external. Procedures Write_Command and Write_Parameter have already been discussed in detail. I will now describe the remainder of the procedures.

Start_Rx. This procedure initializes the current frame pointer with the address of the part of the frame block that will be filled in during a receive operation. The DMA controller is given this address and the length of the frame information field minus 1. The 8273 is initialized for general receive, and the parameters written to the device are the low and high byte of the count of bytes to receive. The DMA device is unmasked and the procedure exits.

Init_8273. This procedure initializes the 8273 on power-up. The device is reset by writing a 1 to the reset port, and then, 10 ms later, writing a 0. Other commands written during this procedure set up the desired operating mode of the 8273.

L1_Xmit_Frame. This procedure is the interface between the level 2 and the level 1 modules. The frame to be transmitted is indexed by the Tx_Index parameter. The address of this frame is set in Tx_Ptr, which is used to intialize the DMA device for transmit. In order to start frame transmission after the DMA device has been initialized, the procedure writes the appropriate command to the 8273, followed by the length of the frame.

Tx_8273. Upon acknowledging the transmit interrupt, the procedure tests the status register to see if the interrupt results are ready to be read from the results register. The procedure reads the results to determine the nature of the interrupt. In a non-DMA mode, code at this point would determine if this interrupt occurred in execution phase rather than result phase and, if so, would feed the 8274 another byte to transmit. The results are analyzed to determine if the frame transmission was good (the operating system is notified) or bad (the error handler is notified).

Rx_8273. This interrupt procedure is called upon completion of a DMA read into buffer memory. As in the transmit procedure, the interrupt results must also be read into a buffer. Three result bytes describe frame status (good, bad CRC, etc.) and two bytes give frame length. As there is a possibility that device failure may trigger this interrupt, there is a loop counter which, if decremented to zero, calls an error handler in the operating system.

In a non-DMA environment, the interrupt procedure would determine if

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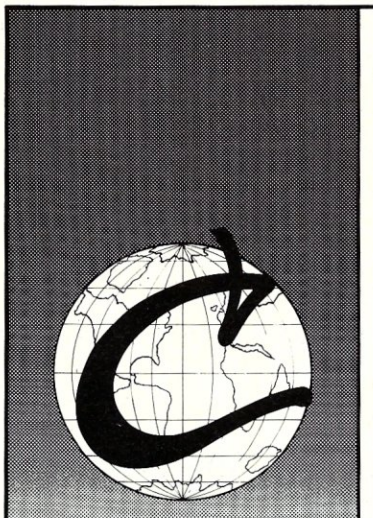

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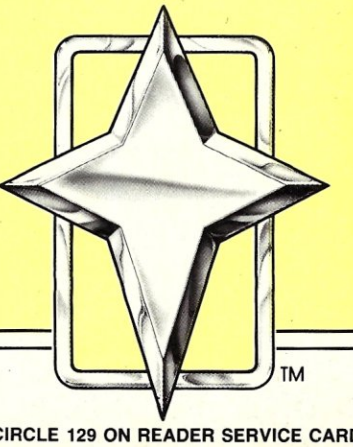

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X.25 PROTOCOL

Continued from page 102

the interrupt took place because there is another byte to read or because the frame reception has ended. If the former, another character would be read into a buffer and the routine would exit.

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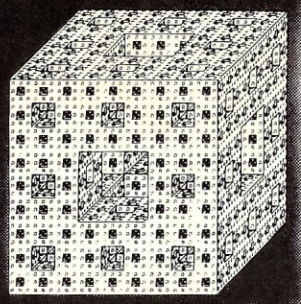

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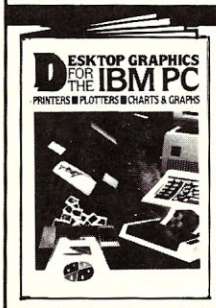

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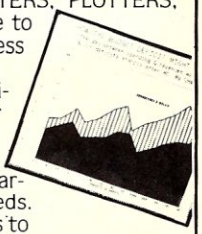

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Printer Networking in TurboDOS

TurboDOS, by its nature, is also a network operating system.

by Tedd Kurts

In working with TurboDOS users on a daily basis, I have observed many of them attempting printer configurations, only to find their efforts unsuccessful. The problem appears to stem from a lack of understanding of the printer networking concepts involved. This article will outline the steps necessary to configure a TurboDOS system with one or more printers.

There is a radical difference between CP/M or MP/M systems and TurboDOS. No printer drivers (or only skeletal examples) are supplied with a CP/M or MP/M as purchased from Digital Research, Inc. The user must write his own drivers and integrate them into the I/O section of the operating system; he must therefore be a competent assembly language programmer and understand the workings of the CP/M BIOS or MP/M XIOS. TurboDOS, on the other hand, comes with several printer drivers for various methods of handshaking; these are assembled in relocatable format and need only be linked to the body of the operating system by means of the GEN utility (also supplied). For fine tuning, parameter files can be created or modified with a simple text editor. Thus, the person who "generates" a bootable system from the modules supplied in relocatable form need not be an assembly language programmer, though he must understand what functions the drivers and parameter files perform, and how to modify them to meet his needs.

The procedure falls into the following steps:

- Determine the handshaking required by your printer(s) and select the appropriate driver module(s).
- Determine the baud rate to be used and create a corresponding patch in a parameter file.
- Assign the printer to a spooling queue by a patch in a parameter file.

Examples will be given, showing exactly how to perform these steps.

Printer handshaking and cabling

To determine what handshaking protocol should be used (and consequently which driver module to select), consult your printer manual. The most commonly used methods are hardware handshake, sometimes called CTS (Clear to Send) protocol; XON/XOFF protocol; ETX/ACK protocol; or a combination of hardware handshake and one of the other two. All of these can be used with serial printers; a special form of hardware handshake, standardized by Centronics, is generally

used for parallel printers.

When hardware handshaking is used on an RS-232 serial channel, only three conductors are required: the data line (from computer to printer); a control signal line; and the signal ground line. The printer accepts characters until its buffer is about three-quarters full; it then turns off the control signal. The computer must be able to detect this signal and stop sending until the printer turns the signal on again when the buffer is nearly empty. The control signal chosen is usually DTR (Data Terminal Ready, pin 20) or RTS (Request to Send, pin 4), but some printers use other signals. This is the industry-preferred protocol, for several reasons: 1) only one data channel is needed; 2) it is a hardware handshake and therefore the driver is simpler and takes less CPU time; 3) a cable disconnection during printing does not cause loss of data. When the cable is reconnected, printing picks up where it left off.

When XON/XOFF protocol is used, two data channels are required: one from computer to printer, the other from printer to computer. The printer accepts characters until its buffer is nearly full, and then sends the ASCII character XOFF (11 hex) to tell the computer to stop sending; when the printer is ready to accept more characters, it sends the ASCII character XON (13 hex).

When ETX/ACK protocol is used, two channels are again required. The computer sends a fixed number of characters to the printer (amounting to about 75% of the buffer capacity) followed by an ETX (End-of-Text, 03 hex) character; it then waits until it receives an ACK (Acknowledge, 06 hex) character from the printer.

Both XON/XOFF and ETX/ACK can lose data in the event of a cable disconnection. For this reason, they are sometimes combined with a hardware handshake.

If the printer can use more than one of these protocols, selection is done by setting switches or placing jumpers on the circuit board.

Parameter files can be created with a simple text editor.

Care must be taken to see that the cable connects the correct pins of the RS-232 connectors at each end. Devices designated DTE (Data Terminal Equipment) send data on pin 2 and receive it on pin 3; devices designated DCE (Data Communications Equipment) receive on pin 2 and send on pin 3. Thus the cable connecting a DTE device to a DCE device has corresponding pin numbers connected. If, however, both devices are DTE or both are DCE, then the cable connecting them must have pins 2 and 3 at one end connected to pins 3 and 2 at the other. Also, if the control signal appears on (say) pin 14 at the printer but is required on pin 20 at the computer end, the cable must have this cross connection also.

Printer drivers

For each of the protocols described above, TurboDOS has a corresponding driver. The most common ones are designated LSTCTS.REL (CTS hardware handshaking; LSTXON.REL (XON/XOFF protocol); LSTETX.REL (ETX/ACK protocol); and LSTCEN.REL (a Centronics parallel printer driver used mainly in TeleVideo implementations). Less common are LSTPAR.REL, the driver for a standard Centronics parallel printer; and LST300.REL, a simple, slow-speed, teletype-like serial driver. This has no provision for error detection and relies on the printer being able to keep up with the transmission rate. One or more of these drivers is placed in the *.GEN file of the appropriate server or satellite processor when the GEN program is run to generate the system.

Setting printer baud rates

After determining handshaking and selecting the appropriate driver module, the baud rate should be checked against the default value for that driver. If some rate other than the default is desired, use a text editor to modify the appropriate patch point in the .PAR parameter file containing global symbolic patches for the node. Examples of symbolic patch points are shown in Listing 1.

Print spooling

The two print modes are either spooled or direct. In most multiuser applications, spooled printing is preferred over direct. When a file is spooled, TurboDOS creates a print file on the disk. When the print job is done, TurboDOS will queue the print files for de-spooling in a first-in-first-out (FIFO) manner. Print file de-spooling is a background process that is done automatically.

The de-spool printer assignment table (DSPPAT), in the module LSTTBL,

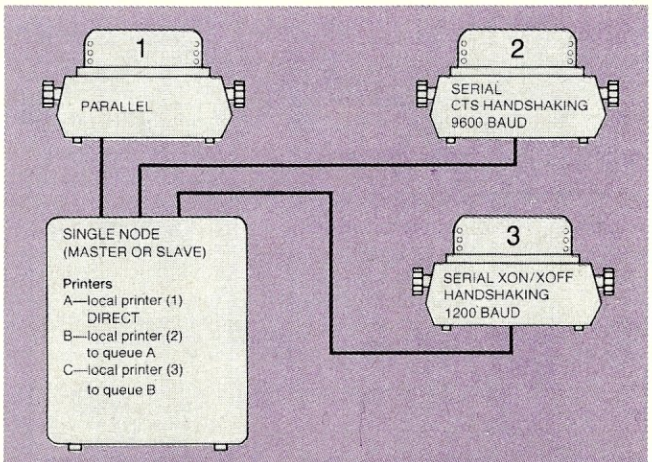


Figure 1. Local printer configuration with parallel CTS and XON/XOFF protocol.

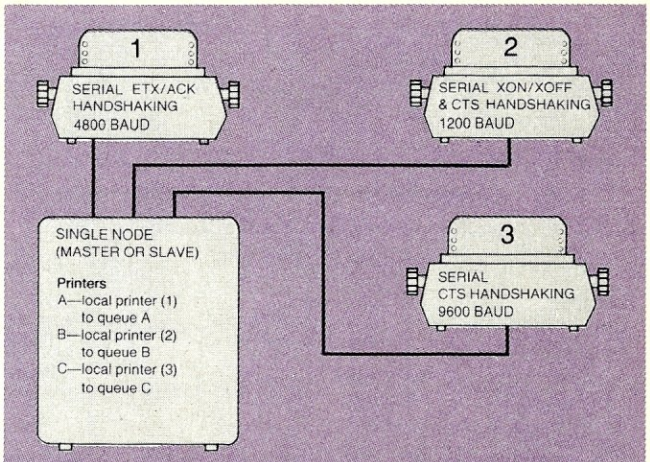


Figure 2. Local printer configuration with ETX/ACK, XON/XOFF plus CTS and high-speed CTS.

Printer Networks

Continued from page 107

is an array of 16 bytes (for printers A-P) that defines the queue assigned to each printer. Positions 1 through 16 in the array correspond to printers A-P, respectively. The hex value (01h-1, corresponding to printers A-P) found at each position in the array defines the queue to which that printer is assigned. A value of 00 indicates that the printer is offline. The default value (01) assigns all printers to queue A. A de-spool assignment table looks like this:

```
DSPPAT = 01,01,02,02 ;Printer A
                     ;to queue A,
                     ;printer B
                     ;to queue A,
                     ;C to B,
                     ;D to B, etc.
```

The files created by the spooler default to the system drive. To change the default, you may patch the symbol SPLDRV in the module LCLTBL, as follows:

```
SPLDRV = 0FFH   ;0FFH is default
                ;for system drive.
                ;Hex value
                ;of 0-F
                ;to specify spool
                ;drive of A-P.
```

The print mode for a local user is determined by the symbol PRTMOD, located in module LCLTBL. The default value is 1, which specifies spooling. To change the default, patch PRTMOD as follows:

```
PRTMOD  = 1 ;1 is default for
            ;spooling.  Hex values
            ;0=direct, 2=print to
            ;console.
```

Print spooling

A print queue is a list of print jobs awaiting de-spooling. The queue assignment table (QUEAST) defines which queues of A-P are local, remote, or invalid. Also specified are the network addresses for each remote queue.

TurboDOS, by its nature, is also a network operating system.

```
QUEAST = 00,(0000),
         0FF,(0000) ;Queue A
                    ;local--1st 3
                    ;bytes zero
                    ;Queue B
                    ;invalid--1st
                    ;byte 0FFH
```

The patch symbol QUEPTR in module LCLTBL specifies initial queue or printer assignments. If print mode is spooled, this symbol specifies a queue assignment. If print mode is direct, this symbol specifies a printer assignment.

```
QUEPTR = 1   ;1 is default. Hex
             ;values of 01-10
             ;represent
             ;assignments
             ;of A-P. 0 signifies
             ;no queue or printer
             ;off-line.
```

Printer assignment

There are two classes of printers in a TurboDOS network: local and remote. The printer assignment table is designated PTRAST, and, for each local or remote printer in the system, contains one byte specifying the printer and two bytes in parentheses specifying the node address of the printer. In the printer designation byte, the high-order nibble can have only two values: 0, signifying a local printer physically attached to the node; or 8, signifying a remote printer attached to some other node. The low-order nibble specifies the printer number (0-FH, corresponding to printers A-P). The following is an example of an entry:

```
PTRAST = 00,LSTDRA,0FF,(0000),
         01,LSTDRA,85,(0002)
```

The various parts of the entry signify the following:

00,LSTDRA—Local printer A to channel zero.

0FF,(0000)—Printer B is invalid.

01,LSTDRA—Local printer C to channel one.

85,(0002)—Printer D is printer E on remote node 2.

In looking at the first bytes (00,0FF,01), we find two local printers attached to this node and one remote. The high-order nibbles (0 and 8) indicate local and remote printers respectively. The low-order nibbles indicate that Printer a is attached to channel 0 (first serial port) and printer C to channel 1 (second serial port).

Local printer configurations

Any node (whether server or satellite) can be configured for up to 16 printers designated A-P. These printers can all be in use simultaneously and have other print jobs waiting in the queue. Before attempting to work with full networking, we will look at local printer configurations.

The example shown in Listing 2

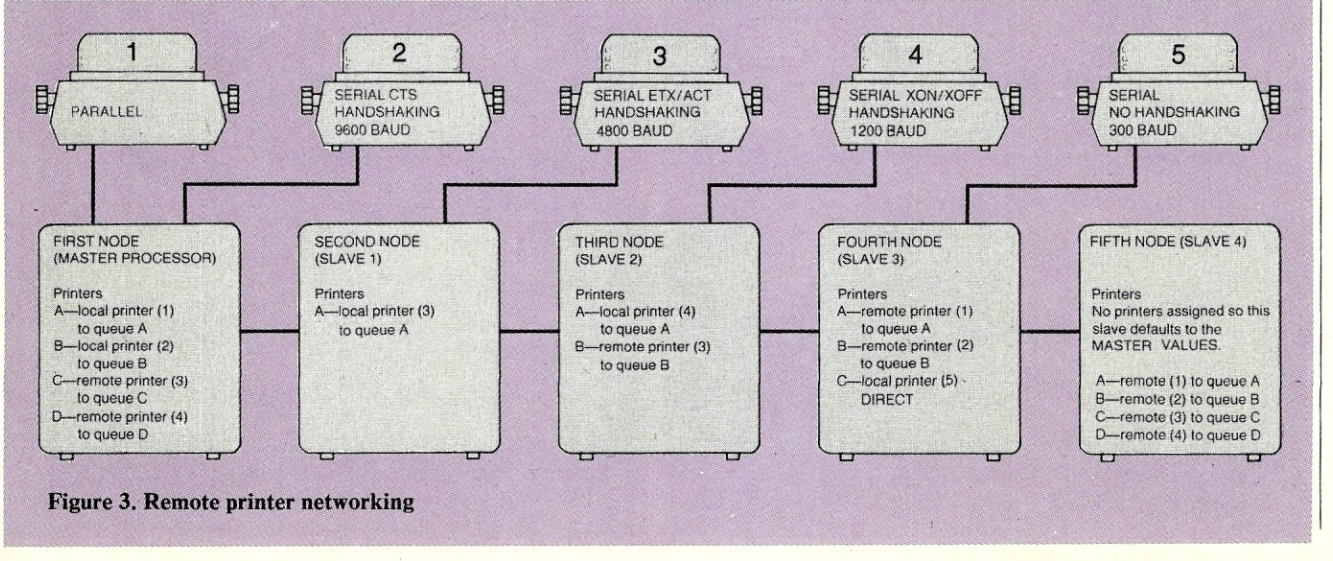
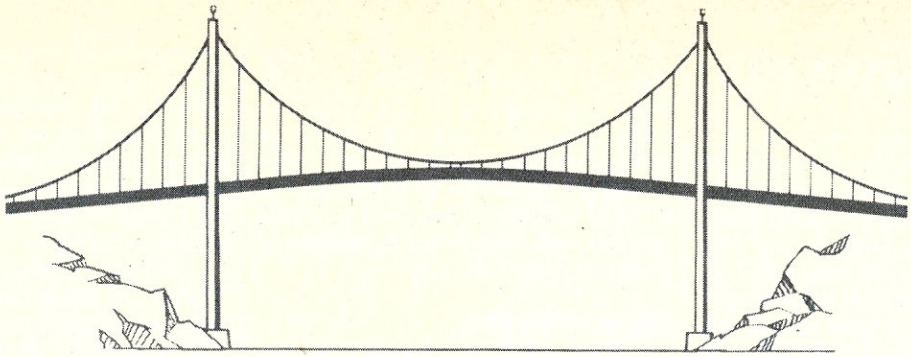


Figure 3. Remote printer networking



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Printer Networks

Continued from page 108

has three printers on a node. The first printer is direct and uses a parallel interface. The second printer is spooled with hardware handshaking at 9600 baud. The third printer is direct, with a software handshake at 1200 baud (see Figure 1). Note that the assignment of LSTDRA is a 2-byte value assigning a local printer to the first printer driver in the *.GEN file. The assignment of LSTDRB is for a local printer using the second printer driver in the *.GEN file, and so on.

Note that the parallel driver (LSTPAR) does not use a serial channel for communication with the printer, and this must be explicitly stated in the PTRAST entry. Note, too, that the positions of the printer drivers in the *.GEN file directly correlate to how printers are assigned in the table. The last letter of LSTDR? tells the printer assignment table which driver to use in the *.GEN—i.e., LSTDR(A) uses the first printer driver in the *.GEN, LSTDR(B) uses the second printer driver, and LSTDR(C) uses the third printer driver.

The example given in Listing 3 shows three printers on a single node. The first printer is spooled with software handshaking (ETX/ACK) at 4800 baud. The second printer is spooled with both a software and hardware handshake (XON/XOFF and CTS) at 1200 baud. The third printer is spooled with a hardware handshake at 9600 baud (see Figure 2).

Printer networking

TurboDOS, by its nature, is a networking operating system that networks via a distributed processing architecture. A TurboDOS circuit is a network communication path between individual processor nodes. In a single-computer system, there is a simple and closely coupled connection between the nodes. An area of confusion to TurboDOS users is printer networking, partly due to a lack of detailed documentation. Listing 4 comprises some examples that will illustrate networking applications.

For a remote printer, the first byte must have the sign bit set. To set the sign bit, the high-order nibble of the first byte must have the hex value 8 to let the local node know that this is a remote printer and is not physically attached. The low-order nibble of the first byte specifies the printer letter to be accessed on the remote processor. The "word" following the first byte specifies the network address of the remote processor, consisting of a circuit and a node. When referring to hardware, a word for an 8-bit processor is 8 bits, and for a 16-bit processor is 16 bits.

When referring to words in TurboDOS (on both 8- and 16-bit processors) a single word is two bytes, or 16 bits. A word is specified in the parameter file whenever a hex value greater than 255 is entered, or when the value is surrounded by parentheses.

Another printer assignment might be written this way:

```
PTRAST = 00,LSTDRA,0FF,(0000),
         01,LSTDRA,83,(0001),
         84,(0001)
```

This assignment defines two printers physically attached to a remote satellite node. Setting the high-order nibble of the first byte to 8 tells the local node (server) that two other printers are remote. The local node (server) "sees" them as printers D and E, corresponding to the order of the printers in the assignment table. The low-order nibbles of the first bytes, with values of 3 and 4 respectively, tell the local system to look to the printer assignment table of the remote node for D and E. The 2-byte entry (circuit 00, node 01) tells the local processor that the remote printers are attached to node 1 of the network (satellite 1).

Printer assignment of remote node (satellite 1) would look like this:

```
PTRAST + 9 = 01,LSTDRA,02,LSTDRA
```

This assignment shows a 9-byte offset resulting from three printers being assigned to the system defaults on node 0. Each printer on node 0 (A, B, C) takes up a 3-byte entry; thus, 3 bytes x 3 system printers = 9-byte offset in remote PTRAST. Printer D is local and physically attached to serial channel #1, while printer E is local and physically attached to serial channel 2.

A remote networking example is given in Listing 5; please refer to Figure 3 for a diagramatic representation. When configuring a network, it helps to draw diagramatic representations like the ones in Figures 1, 2, and 3 to aid in visualizing the network.

References

1) *TurboDOS User's Guide, Programmer's Guide*, and *Implementor's Guide*. Software 2000, Inc., Arroyo Grande, CA; 1983.

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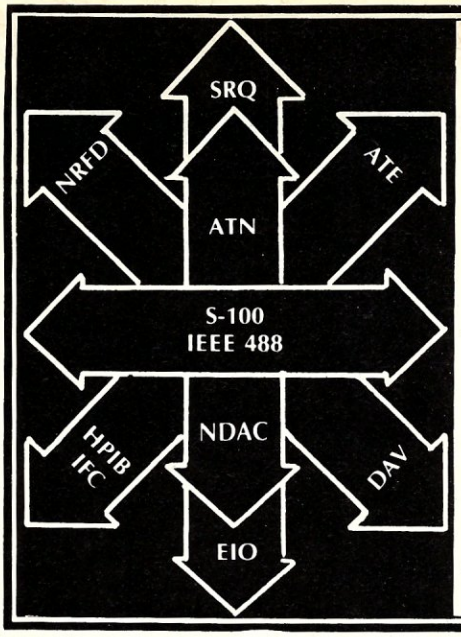
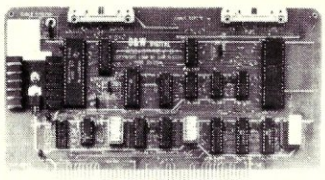


THE 488+3

IEEE-488

IEEE 488 TO S-100 INTERFACE



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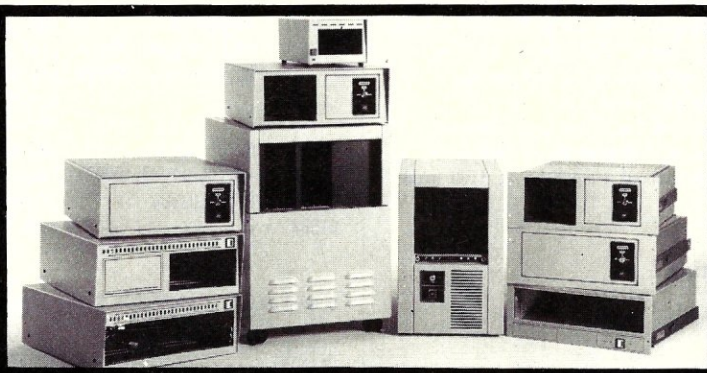

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Listing 1

```
Baud Rate Patch Point (.PAR)          Printer driver (.GEN)
----------------------------          ---------------------
CTSBR = hn ln   Default=6E            LSTCTS
XONBR = hn ln   Default=07            LSTXON
ETXBR = hn ln   Default=07            LSTETX

Here hn represents the high order 'nibble' (four bits) which
can have only three values in these particular patch points:


0  - Represents the disabling of all hardware handshaking.
4  - Represents hardware handshaking.  Bit 6 is set and enables
     CTS.  Is used with XONBR and ETXBR drivers to enable the
     respective protocol + CTS.
6  - Represents hardware handshaking for output only ( input
     disabled ). Is used for all CTSBR patch points.

ln-Represents the low order nibble which can have sixteen
values representing the sixteen baud rate values. The most
common are:

            5 = 300
            7 = 1200
            E = 9600


Example: CTSBR = 6E  ;CTS handshaking at 9600 baud
         XONBR = 47  ;XON-XOFF + CTS handshaking at1200 baud
         XONBR = 07  ;XON-XOFF handshaking at 1200 baud
         ETXBR = 05  ;EfX-ACK handshaking at 300 baud
```

Listing 2

```
NODE.GEN  ;TurboDOS System Generation File

LSTPAR    ;Printer driver for PARALLEL (Centronics) interface
LSTCTS    ;Printer driver for CTS hardware handshake
LSTETX    ;Printer driver for ETX\ACK software handshaking
DSPOOL    ;Despooler for local printer(only goes in satellites)


NODE.PAR  ;TurboDOS Symbolic Patch File

CONAST = 00,CONDRA          ;1st serial channel-console terminal
PTRAST = 00,LSTDRA,01,LSTDRB ;Parallel port-no serial chnl. used
         02,LSTDRC          ;2nd serial chnl.-2nd printer driver,
                            ;3rd serial chnl.-3rd printer driver
DSPPAT = 00,01,02           ;No queue(direct), 2nd ptr queue A,
                            ;3rd ptr queue B
QUEAST = 00,(0000),00,(0000) ;Queue A and B are local queues
CTSBR = 6E                  ;CTS with handshake at 9600 baud
XONBR = 07                  ;XON without handshake at 1200 baud
```

Listing 3

```
NODE.GEN  ;TurboDOS System Generation File

LSTCTS    ;Printer driver for CTS hardware hankshake
LSTETX    ;Printer driver for ETX/ACK software handshake
LSTXON    ;Printer driver for XON/XOFF software handshake
DSPOOL    ;Despooler for local printer(only goes in satellites)


NODE.PAR  ;TurboDOS Symbolic Patch File

CONAST = 00,CONDRA          ;1st channel-console terminal
PTRAST = 01,LSTDRB,02,LSTDRC ;2nd channel-2nd printer driver,
         03,LSTDRA          ;3rd channel-3rd printer driver,
                            ;4th channel-1st printer driver
DSPPAT = 01,02,03           ;Printer A to Queue A, B to B etc.
QUEAST = 00,(0000),00,(0000) ;All queues valid and local
         00,(0000)
CTSBR = 6E                  ;CTS printer at 9600 baud
ETXBR = 0C                  ;ETX/ACK at 4800 baud
XONBR  =  67                ;XON/XOFF + CTS  by  setting  high
                            ;order nibble to 6, at 1200 baud
```

Listing 4

```
PTRAST = 00,LSTDRA,81,(0001)

00  is one byte consisting of a high order nibble (local=0,
remote=8),  and  low  order nibble (local=port  or  channel
number, remote=printer A-F in Hex values of 0-F).

LSTDRA  is a two byte assignment entry (symbolic address  of
driver  entry  point)for  local printers in which  the  last
substitution  character points to the printer driver to  use
in  the GEN file.  eg.  A = First Driver,  B = Second,  C  =
Third.

81 a remote printer which is printer B in remote's PTRAST.

(0001)  is  the remote assignment entry in which  the  first
byte of 00 refers to the circuit,  and the second byte of 01
refers  to  the node on that circuit( circuit 00  =  server,
node 01 = 1st satellite).
```

Listing 5

```
MASTER.GEN     ;TurboDOS Master Generation File

NETREQ                      ;Network request module
MSGFMT                      ;Message format tables for NETREQ
LSTCTS                      ;Printer driver for CTS hardware HS
LSTPAR                      ;Printer driver for PARALLEL HS


MASTER.PAR     ;TurboDOS Master Parameter File

CONAST = 00,CONDRA          ;1st serial ch.-console terminal
PTRAST = 01,LSTDRA,00,LSTDRB ;2nd serial ch.-1st printer driver
         80,(0001),80,(0002) ;Parallel ch. #0-2nd printer driver
                            ;Printer C is prt. A on r-node #1
                            ;Printer D is prt. A on r-node #2
QUEAST = 0,(0),0,(0)        ;Queue A and B valid local queues
         80,(0001),80,(0002) ;Queue C and D valid remote queues
DSPPAT = 01,02,03,04        ;Printer A to queue A, B to B etc.
CTSBR  = 6E                 ;CTS printer at 9600 baud


SLAVE1.GEN     ;TurboDOS Slave 1 Generation File

NETSVC                      ;Network service local prnt request
DSPOOL                      ;Print despooler for local printer
LSTETX                      ;Printer driver for ETX-ACK handshake

SLAVE1.PAR     ;TurboDOS Slave 1 Parameter File

PTRAST = 01,LSTDRA,0FF,(0)  ;2nd serial ch.-1st printer driver
         0FF,(0),0FF,(0)    ;Printer B, C, D, are invalid
```

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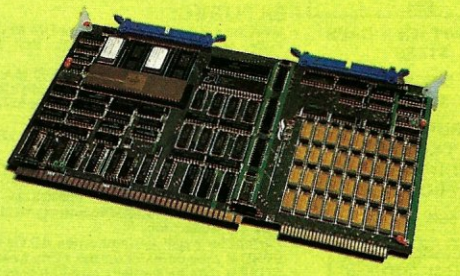

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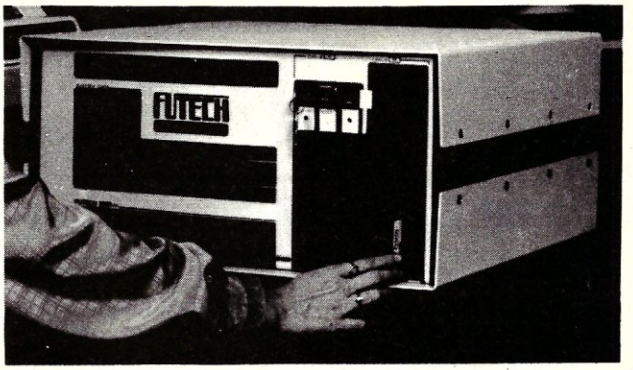

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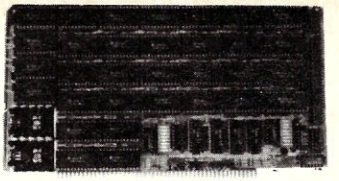

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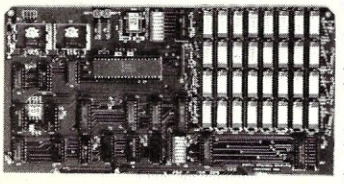

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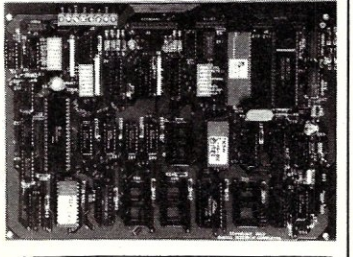

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Printer Networks

Continued from page 112

```
QUEAST = 0,(0),0FF,(0)          ;Local queue A valid.Queue B,C,and
         0FF,(0),0FF,(0)        ;D are invalid
ETXBR  = 0C                     ;ETX-ACK handshaking at 4800 baud


SLAVE2.GEN      ;TurboDOS Slave 2 Generation File

NETSVC                          ;Network service local prnt request
DSPOOL                          ;Print despooler for local printer
LSTXON                          ;Printer driver for XON handshake


SLAVE2.PAR      ;TurboDOS Slave 2 Parameter File

PTRAST = 01,LSTDRA,82,(0000)    ;2nd serial ch.-1st printer driver
         0FF,(0),0FF,(0)        ;Printer B is ptr. C on r-node #0
                                ;Printer C, and D invalid
QUEAST = 0,(0),82,(0)           ;Local queue a valid. Queue B is
         0FF,(0),0FF,(0)        ;queue C on r-node #0
DSPPAT = 01,02                  ;Printer A to queue A, B to B etc.


SLAVE3.GEN      ;TurboDOS Slave 3 Generation File

LST300                          ;Serial driver default 300 baud
                                ;NETSVC  required  because  of  no
                                ;local printer

SLAVE3.PAR      ;TurboDOS Slave 3 Parameter File (example 1)

PTRAST = 80,(0000),81,(0000)    ;Printer A is ptr. A on r-node #0
         01,LSTDRA,0FF,(0000)   ;Printer B is ptr. B on r-node #0
                                ;Printer C is a local printer.
                                ;Printer D is invalid
QUEAST = 80,(0),81,(0)          ;Queue A is queue A on r-node #0
         0FF,(0),0FF,(0)        ;Queue B is queue B on r-node #0
                                ;Queue C and D are invalid
DSPPAT = 01,02                  ;Printer A to queue A, B to B
                                ;No baud rate specifies so it goes
                                ;to default

SLAVE3.PAR      ;TurboDOS Slave 3 Parameter File (example 2)

PTRAST +6 = 01,LSTDRA,0FF,(0)   ;Offset of 6 bytes for first two
                                ;printers A and B. A and B default
                                ;to the server PTRAST
QUEAST +6 = 0FF,(0),0FF,(0)     ;6 byte offset for the two system
                                ;printers off the server. Queues C
                                ;and D are invalid
DSPPAT = 01,02                  ;Queue A to queue A, B to B


SLAVE4.PAR
```

This satellite does not require any printer drivers in the SLAVE4.GEN. In the SLAVE4.PAR, it will require no printer or queue assignment. This satellite defaults to the server, but a sample *.PAR is shown below to illustrate the defaults.

```
SLAVE4.PAR

PTRAST = 80,(0),81,(0)          ;Defaults for system printers
         82,(0),83,(0)          ;
QUEAST = 80,(0),81,(0)          ;Default queues for system
         82,(0),83,(0)          ;printers
```

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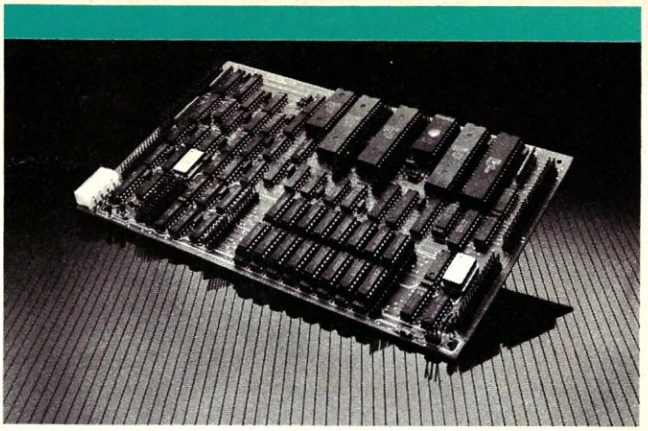

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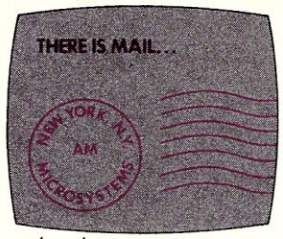

Letters to the Editor

This month... the WD2511 X.25 chip; a differing opinion on our editorial emphasis

Dear Sir,

Regarding the article "Implementing X.25 Communications Protocol" by Eric Beser (June '84), I feel that I must clarify one point. The Western Digital WD2511 X.25 LSI chip mentioned in that article under the section "Physical Layer" in fact actually implements the full datalink layer of the X.25 protocol. This chip has passed the datalink layer certification tests on the GTE Telenet Packet Switching Network as well as on several other public data networks.

If your readers are faced with having to implement the protocol described by Mr. Beser but were confused after reading the article, they can save themselves a lot of trouble by using the Western Digital chip. Not only does it implement this complex protocol, but it also includes the timers, buffer management, retransmission counters, and DMA circuitry necessary to the successful implementation of this protocol.

I will be happy to answer any questions regarding this chip.

Cynthia S. Magidson
X.25 Product Manager
Western Digital Corp.
2445 McCabe Way
Irvine, CA 92714
(714) 863-0102

Editor's Note: Part 2 of Eric Beser's series on X.25 Protocol appears in this issue and covers the drivers and hardware needed to implement the physical layer. Specifically, Eric discusses the Intel 8273 HDLC device. The Intel 8274 Multiple Protocol Serial Converter and the Western Digital WD2511 Level 2 controller will be covered in Part 3.

Gentlemen:

I wish to comment on the continuing trend in your magazine's editorial policy to move away from support of the S-100 systems. My original interest in your magazine was for S-100 CP/M information, and our paths seem to be divergent.

As I'm sure you're aware, the S-100 systems are far from dead. CompuPro systems, for one OEM, are selling like never before, and from information from your own publication, I understand that the S-100 market is not expected to peak for another four years. I'm sure you realize that there is a great need of support for these larger, more flexible/complex systems that I was hoping that your magazine would provide.

There is also a growing base of CP/M-86 and Concurrent CP/M-86 users who are being left out in the cold. Naturally, CP/M-86 will die in time if the press keeps publishing death notices. If I had wanted to learn more of the UNIX system, or of MS-DOS and the IBM -PC, I would not have suscribed to a CP/M S-100 oriented magazine.

It is unfortuante that the microcomputer world is changing to such a "ram it down their throats" business-oriented market. I fully understand that you want to increase your circulation; please do not attempt to do it at the expense of a fine magazine.

I challenge you to consult your readership in an honest unbiased poll to see what the people who *pay* you want.

I'd also like to comment on your recent review of modems. This article was not up to your old standards, and as a person who is shopping for a new 300-1200 auto-answer auto-dial modem, I must say that I was severely disappointed. First, there was no real depth to the article. Secondly, no real comparisons were made between either the features or performance of the models presented. In short, this article did not help me in selecting a product to purchase; a disservice to both your readership and advertisers was the result.

David L. Speed
7131 Owensmouth,
Suite B-113
Canoga Park, CA 91303

The editor replies: We are sorry you were disappointed in Dave Hardy's article on modems (in our June issue). Perhaps the fault was ours in calling it "A Comparison," instead of giving it a more general title. We agree that it contained no detailed performance comparisons between similar features on the different modems. However, it certainly did list the major features and commands available on each of the modems discussed. For comments relating to your other points, see the Editor's Page in this issue.

Correction: In the September issue of *Microsystems*, the following addresses were omitted from Todd Katz's "PMATE-The Programmer's Tool."

PMATE is available from:
Phoenix Computer Products Corp., 1416 Providence Highway, Suite 220, Norwood, MA 02062; (800) 344-7200; in MA: (617) 769-5030. PC/MS-DOS version: $225, CP/M version: $195.
Lifeboat Assoc., 1651 Third Ave., NY, NY 10128; (800) 847-7078; in NY: (212) 860-0300. Both versions: $225.

XERGO ($335) is available from:
Landmark Software, 1142 Pomegranate Count, Sunnyvale, CA 94087; (408) 733-4032

Product prices are generally reduced for registered owners of PMATE.

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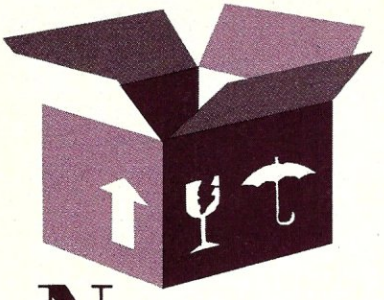


New Products

What's new: a quick roundup of recent innovations and improvements

HARDWARE

Sperry Personal Computer

The Sperry Personal Computer interfaces with both Sperry and IBM central processors through standard and optional communications interfaces, such as IBM's bisynchronous and SNA/SDLC protocols. The Sperry Personal Computer can operate at a speed of 7.16 MHz; a unique switch selection also allows operation at a slower speed of 4.77 MHz to emulate an IBM. There are two color-display monitors: a medium-resolution display, providing standard graphics resolution and color features, as well as a high-resolution color display. Sperry achieves a maximum of 256,000 dots of resolution and allows 16 colors; a maximum of 256 colors may be displayed at one time. In the high-resolution graphics mode, the Sperry Personal Computer offers the ability to use four different pages, switching screens instantaneously. It is possible to superimpose and change both graphics and text data at the same time. Sperry's extrafunction keyboard has an IBM-lookalike layout for ease of concurrent use, and offers the following additional features: clearly defined key captions instead of cryptic arrows; lock key indicators; an extra ENTER-key placed conveniently next to the numeric pad, and SHIFT- and RETURN-keys in more familiar typewriter locations. The Sperry Personal Computer is available in seven models.

Price: $2,643 to $5,753 depending on model. Model differences relate to monochrome or color monitor choice, diskette capacity and fixed disk options; selections are priced separately.

Sperry Corp.
P.O. Box 500
Blue Bell, PA 19424
(215) 542-4213/2504

CIRCLE 306 ON READER SERVICE CARD

Three new S-100 boards

L & J Engineering has introduced three new S-100 boards: the Intelligent Peripherals Controller (IPC), the Clock/Watchdog, and the PIO.

The IPC board can be used as an intelligent I/O board for S-100 systems or standalone computers. It features a Z80B 6 MHz processor with a 9519 interrupt controller for efficient vectored interrupts; eight serial ports (four with full handshake); four onboard counter timers; up to 32K of EPROM; 32K of static RAM; dual-port onboard RAM available to S-100 bus through either bank-select or 24-bit addressing; two bidirectional I/O ports to S-100 bus for additional control (status and command ports); interrupts to S-100 bus either through use of VIO-V17 or auto vector; five LEDs, four user programmable and one for S-100 memory select; board reset accomplished either through S-100 bus or onboard switch; optional battery backup for RAM, and onboard RS-232C drivers.

The Clock/Watchdog board features outputs (month, date, day of week, hours, minutes, seconds: (0.1/0.1 seconds); 24- or 12-hour time format; precision quartz crystal clock; vectored interrupt capability with interrupt control latch; adjustable threshold on power loss circuit; battery backup; DIP switch-selectable port address; ability to reset system; variable time-out length; count reset and an adjustable reset attempt (to prevent disk wear-out).

The PIO board outputs can drive mechanical or solid state relays to turn on lights, parallel printers, drive display panels, etc. It is compatible with all IEEE-696 systems and features 64-bit outputs and 32-bit inputs.

Prices: IPC: $747; Clock/Watchdog: $388; PIO: $428

L & J Engineering
2800 E. Bernice Rd.
Lansing, IL 60438
(312) 895-4311.

CIRCLE 302 ON READER SERVICE CARD

Amdek 5055 Printer

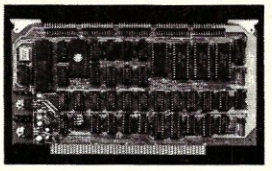
The Amdek 5055 is a 55-character per second, letter-quality daisywheel printer with a built-in buffer to store up to 2,048 characters at a time. The printer operates at a 50 dB noise level and is designed with both RS-232C and Centronics/IBM Parallel interfaces enabling the printer to be compatible with most personal computers and word processing machines. The unit prints in both directions with adjustable character spacing of 10, 12, or 15 characters

per inch. The printer is able to handle paper up to 16″ wide to accommodate spreadsheets.

The 5055 has a double-daisywheel to accommodate up to 125 characters on a single wheel. A side variety of typeface are available to suit all kinds of print requirements. External software controls allow the 5055 to print up to 309 international Teletex characters. A

Extended Processing S100 Boards

POWER I/O



High performance S100/IEEE-696 smart slave computer with 64K RAM, 3 serial ports, 1 centronic port, comprehensive 4K operating system in EPROM and 1 timer. Host access is through a high speed parallel I/O port. Accepts 256K RAMS when available. Optional ADD-ON board doubles I/O and RAM. Standard software and hardware supports 6 serial ports, 2 parallel ports and 512K of RAM. Entire board is software programmable including all I/O buffer sizes.

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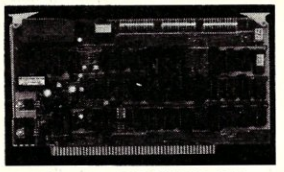

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New Products

Continued from page 118

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Price: $175; Tel-A-Switch with Tel-A-Switch remote-access software costs $287.

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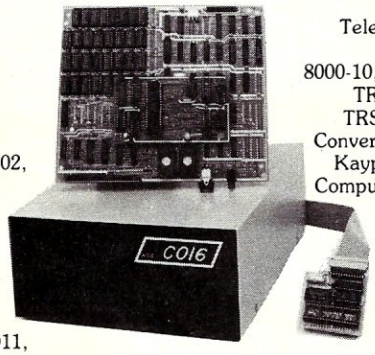

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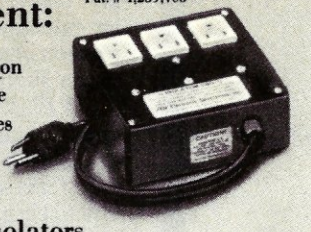

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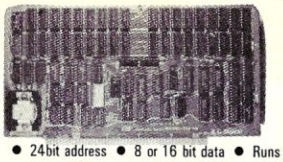

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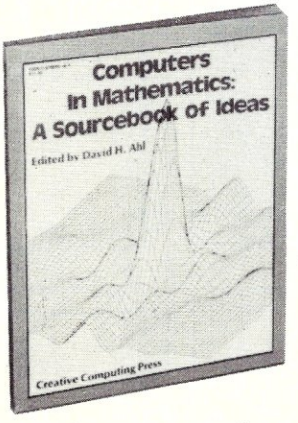

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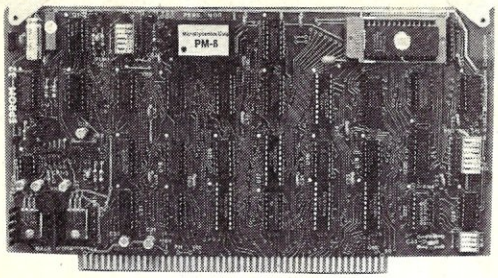

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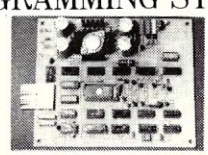

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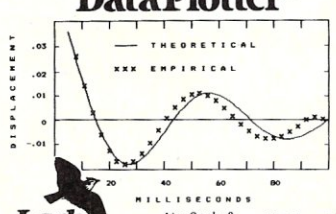

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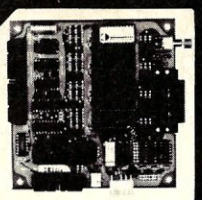

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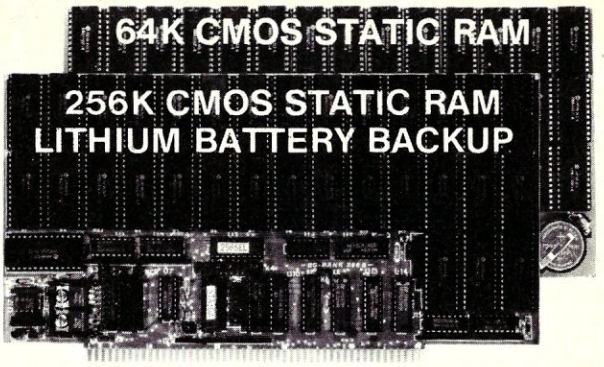

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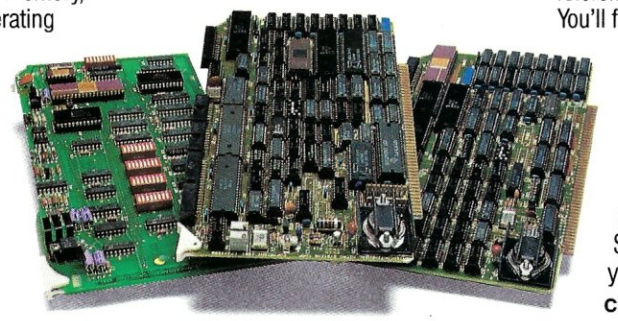

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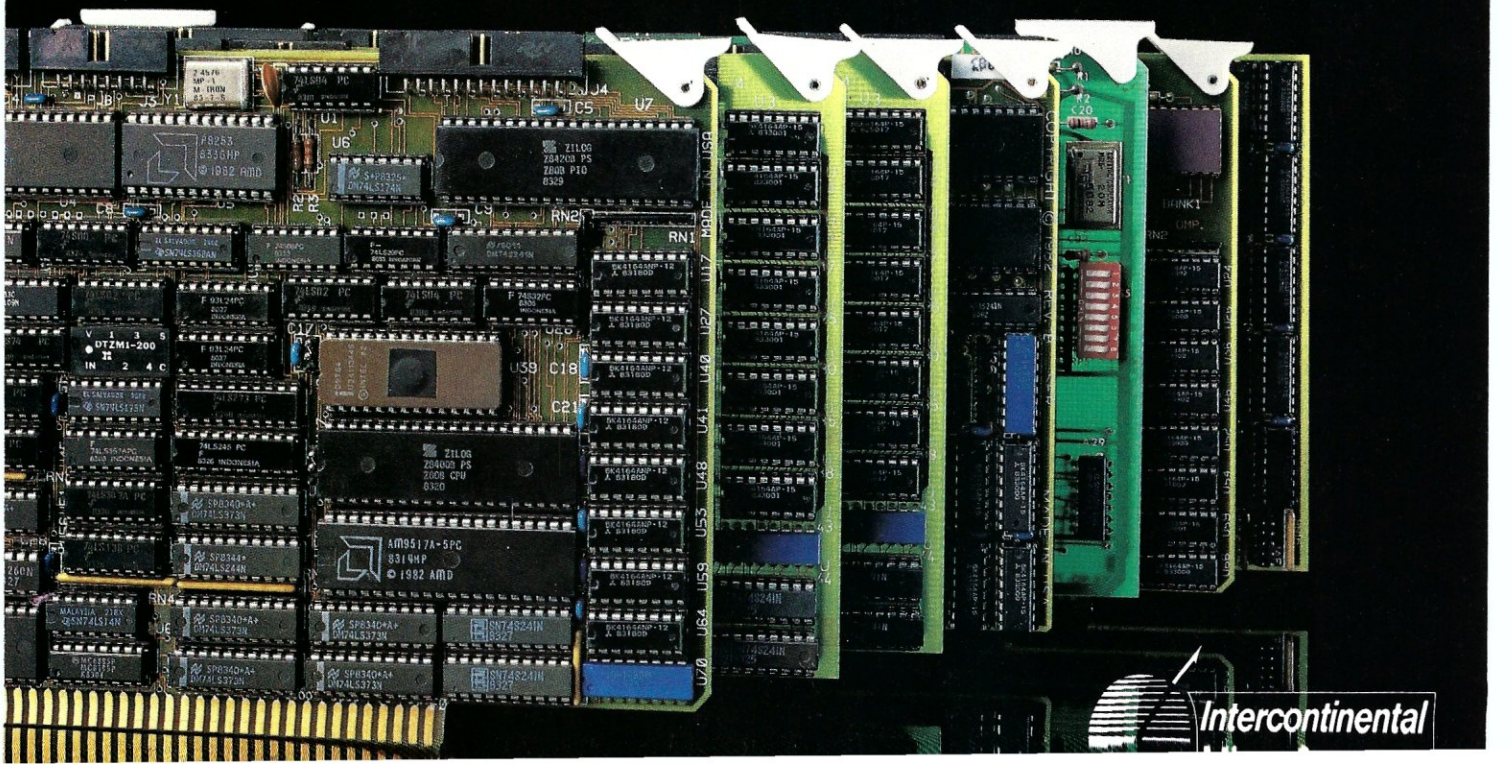

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